LIBRARY
FISH & WILDLIFE SERVICE
PACIFIC OCEANIC FISHERY
INVESTIGATIONS

THE DANISH "DANA"-EXPEDITIONS 1920—22
IN THE NORTH ATLANTIC AND THE GULF OF PANAMA
LEADER: PROFESSOR *JOHS. SCHMIDT*, PH. D., D. SC.
OCEANOGRAPHICAL REPORTS EDITED BY THE "DANA"-COMMITTEE
**No. 7**

# ORNITHOLOGICAL OBSERVATIONS
IN
# THE NORTH ATLANTIC OCEAN

BY

P. JESPERSEN

WITH 19 FIGURES IN THE TEXT

*PUBLISHED AT THE COST OF THE RASK-ØRSTED FUND*

COPENHAGEN
GYLDENDALSKE BOGHANDEL

LONDON
WHELDON & WESLEY LTD.

PRINTED BY BIANCO LUNO A/S — COPENHAGEN 1930

# CONTENTS


| | | Page |
|---|---|---|
| I. | INTRODUCTION | 3 |
| II. | A SURVEY OF THE MATERIAL OF ORNITHOLOGICAL OBSERVATIONS | 4 |
| III. | ON THE FREQUENCY OF BIRDS ON THE OPEN ATLANTIC | 8 |
| IV. | A SYSTEMATIC SURVEY OF THE SPECIES OF BIRDS OBSERVED | 15 |
| | LIST OF PUBLICATIONS CITED | 36 |

# I. INTRODUCTION

On the various transatlantic research expeditions sent out from Denmark, under the leadership of Professor, Dr. Johs. Schmidt, observations of bird-life on the open sea were made at the same time marine biological and hydrographical investigations were being carried out. As far as circumstances permitted, daily observations of bird-life were made during these cruises, and it is on the records in these diaries that this paper is based.

In what follows, notice has, in all essentials, been taken only of the avifauna of the Atlantic itself, and the observations made use of treat mainly only of the species of birds that are met with out over the open sea. It need hardly be said that ornithological observations were also carried out along the coasts, but as, in most instances, the visits ashore were of but short duration and did not therefore admit of thorough investigations being made, these observations of the coast-birds are of a very casual character and have therefore generally been omitted in this paper which, primarily, is an attempt to extend our knowledge of the avifauna out over the open Atlantic.

The ornithological observations were made on board the following vessels during their cruises in the north Atlantic: M/S "Margrethe" 1913, M/S "Dana" 1920 and 1921 and the research steamer "Dana" 1921—22 and 1928 but besides these a series of observations made from various passenger boats on their voyages across the Atlantic to and from the U. S. A. and the West Indies and to the Mediterranean, have been taken into consideration. On page 4, where the observation material is discussed in detail, further particulars will be found of the various cruises and the routes of the passenger boats from which ornithological observations were made.

There are several difficulties attending the observation and the determination of the birds from a vessel out on the open sea. In many instances they remain so far from the ship that a decision as to species is out of the question, and even with a good pair of binoculars it is often impossible to identify the species with certainty. It must be remembered that in by far the majority of cases the birds are seen in flight, it being quite an exception out on the great oceans, to see them resting on the water. Observations from a ship at sea are, moreover, often rendered difficult by the pitching and tossing of the vessel or by the unfavourable state of the light but generally, however, it is the great distance from the birds under observation which is accountable for the uncertainty of the determination. Thus a number of birds are seldom seen in the immediate vicinity of the vessel, but almost always keep at a rather considerable distance from the ship. This is particularly the case with the several species of Shearwaters (*Puffinus*) and to some extent with Skuas (*Stercorarius*). Even if one has an opportunity to observe the birds fairly close at hand, it is often very difficult to identify the various species, as their specific characters in several cases are so slightly distinctive that it requires a particularly practised eye to recognise the different species when in flight[1]. Birds resting on the water take wing, as a rule, long before the ship comes in their neighbourhood, and it is quite an exception for birds belonging to the open sea to settle on the vessel. The author of these lines has particularly experienced difficulty in identifying the various species

[1] On the cruise with the research steamer "Dana" in the summer and autumn of 1928 I, with great advantage to myself, made use of W. B. Alexander's handbook "Birds of the Ocean" (G. P. Putnam's Sons, New York—London 1928).

of Storm Petrels (*Hydrobatidæ*), but besides it has frequently not been possible to determine the species — particularly young individuals — of the families *Procellariidæ* and *Stercorariidæ*.

The effect of this uncertainty in determining the birds mentioned, has been that, in some cases, I have preferred giving a more collective treatment of the birds to making a more detailed statement. For the determination of species is, in many cases, so uncertain that the relatively few positive data would not give any reliable picture of the distribution of the individual species.

On the cruises there were only very rarely opportunities of shooting birds out on the open sea, partly because it is very difficult to get the bodies on board and partly because, on account of other work, there was often little or no time to prepare them. On the cruise of the M/S "Margrethe" in 1913, which extended over six months, I, however, succeeded from time to time in collecting a fairly considerable number of skins of ocean birds. I had prepared a list of the skinned birds with a description of them but unfortunately the collection as well as the list was lost when the "Margrethe" was wrecked on the little West Indian island, Anegada, at Christmas time in 1913. Fortunately I succeeded in saving my diary of ornithological notes, but these would, naturally, have been of far greater value had I been able to bring home the collection of bird skins referred to. The wreck, moreover, occasioned the loss of a collection of the skins of about 70 birds from the Bermudas, which had been received as a present from a Danish gentleman living there.

During the cruises a great part of the day was most often devoted to work in the laboratory. The most complete observations are those made during the above mentioned cruise with the M/S "Margrethe" in 1913, which extended from the Faroe Islands to the West Indies; on board this vessel my work did not take up so much of my time as it did on subsequent cruises, I had therefore better opportunities, on that occasion, of making ornithological observations. As it was a sailing vessel the conditions for favourable observations were also generally better than from subsequent vessels, for, as a rule, it is possible to approach closer up to the birds with a sailing vessel than with a motor- or steamship.

In most cases the ornithological observations were made by myself but on the cruise of the research steamer "Dana" in 1921—22 they were made in co-operation with Dr. Å. Vedel Tåning; Captain G. Hansen, who for many years has been master of the research vessels, has always wished that the ornithological investigations should be as comprehensive as possible has, during several voyages, kept ornithological diaries which he made over to me on arrival home. My thanks are due to Dr. Tåning and Captain Hansen for their valuable assistance and I most sincerely thank Professor, Dr. Johs. Schmidt, who has always regarded the ornithological observations with great interest, for permission to include these observations in this series of publications.

## II. A SURVEY OF THE MATERIAL OF ORNITHOLOGICAL OBSERVATIONS

The material of ornithological observations to hand was collected on a series of investigation cruises and voyages in the North Atlantic. To give an idea of from which parts of the Atlantic investigations are available, the routes of the various expeditions and passenger boats, from which observations were made, are shown on the chart below (Fig. 1).

In the survey below is given a brief report of the various cruises and voyages where ornithological observations were made. Where not otherwise stated, the observations were made by the author.

1913. M/S "Margrethe". From 11th June to 21st December. Route: The Faroes—Azores—Newfoundland—Bermudas and thence in an easterly curve to St. Thomas (The West Indies).

1914. S/S "Samui". From 11th to 28th March: Route: St. Thomas—The Channel.

1920. M/S "Dana". From 17th March to 5th May: The Channel—Gibraltar—Madeira—St. Thomas. From 2nd June to 4th July: St. Thomas—Bermudas. On the remainder of the cruise from 8th July to 3rd September: Bermudas—Florida—New York—The Channel ornithological observations were made by the master of the ship, Captain G. HANSEN.

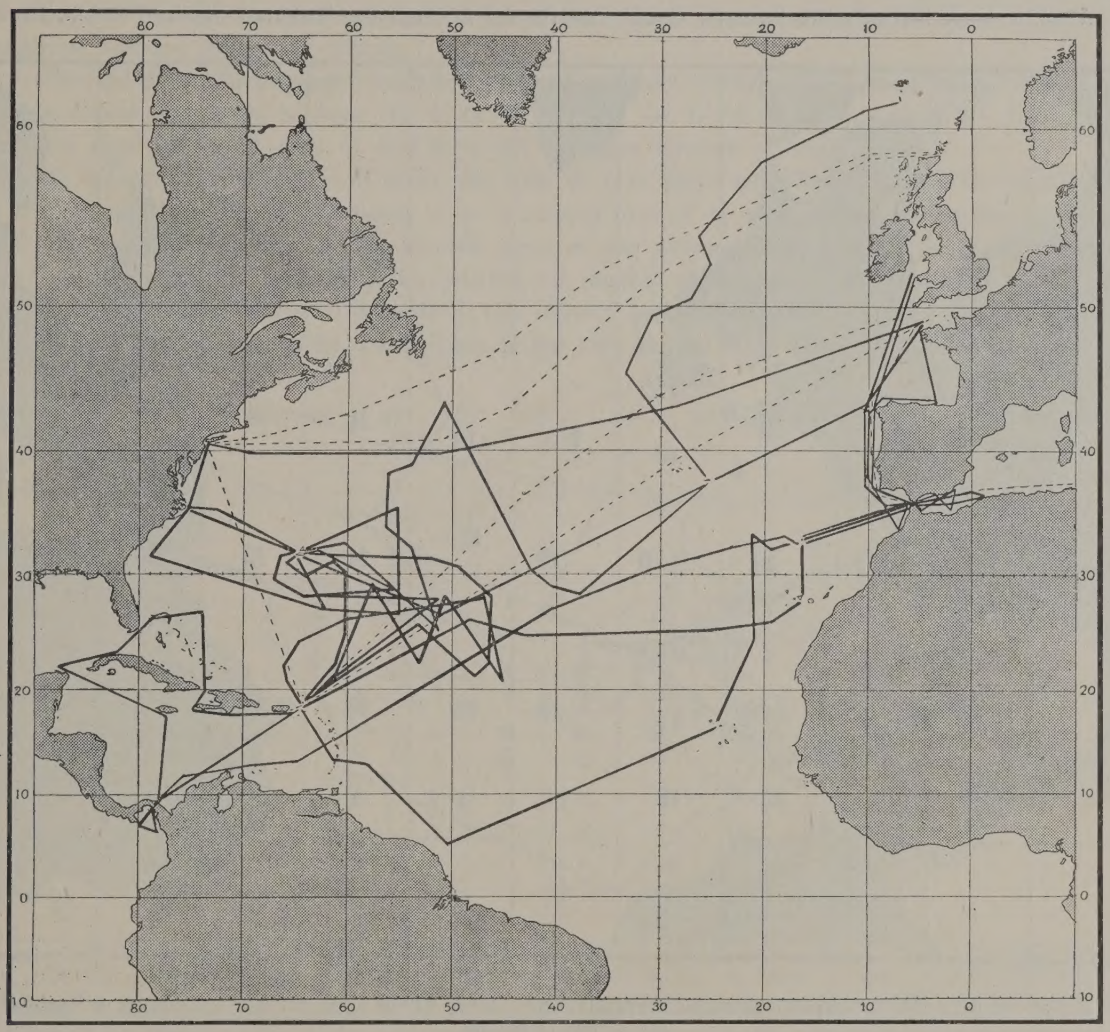


Fig. 1. Chart showing the routes of the research ships and passenger boats from which ornithological observations were made. The continuous lines indicate the routes of the research vessels and the dotted lines those of the passenger boats.

1920. S/S "Fort Hamilton". From 6th to 8th July: Bermudas—New York.

1920. S/S "United States". From 15th to 24th July: New York—Orkney Islands.

1921. M/S "Dana". From 24th February to 2nd May: From St. Thomas a cruise in the Sargossa Sea to 45° W. long. and back to St. Thomas. On this cruise the ornithological observations were made by Captain G. HANSEN as also when outward bound to the West Indies via the Orkney Islands—New York and thence to St. Thomas from 13th Dec. 1920 to 13th January 1921 and on the homeward voyage from the West Indies to the Channel from the 19th May to the 3rd June 1921.

1921—22. The cruise of the research steamer "Dana" from 8th Sept. 1921 to 26th June 1922, where the ornithological observations were made by Dr. Å. Vedel Tåning and the author. The route of the cruise was, roughly: The Channel — the western Mediterranean (Algiers) and thence via Gibraltar—Madeira — the Cape Verde Islands to off Cayenne (French Guiana). Thence via Barbados to St. Thomas. From St. Thomas the route went through the Panama Canal with a ten days stay in the Pacific, back through the Panama Canal and thence through the Yukatan Strait, Florida Strait to

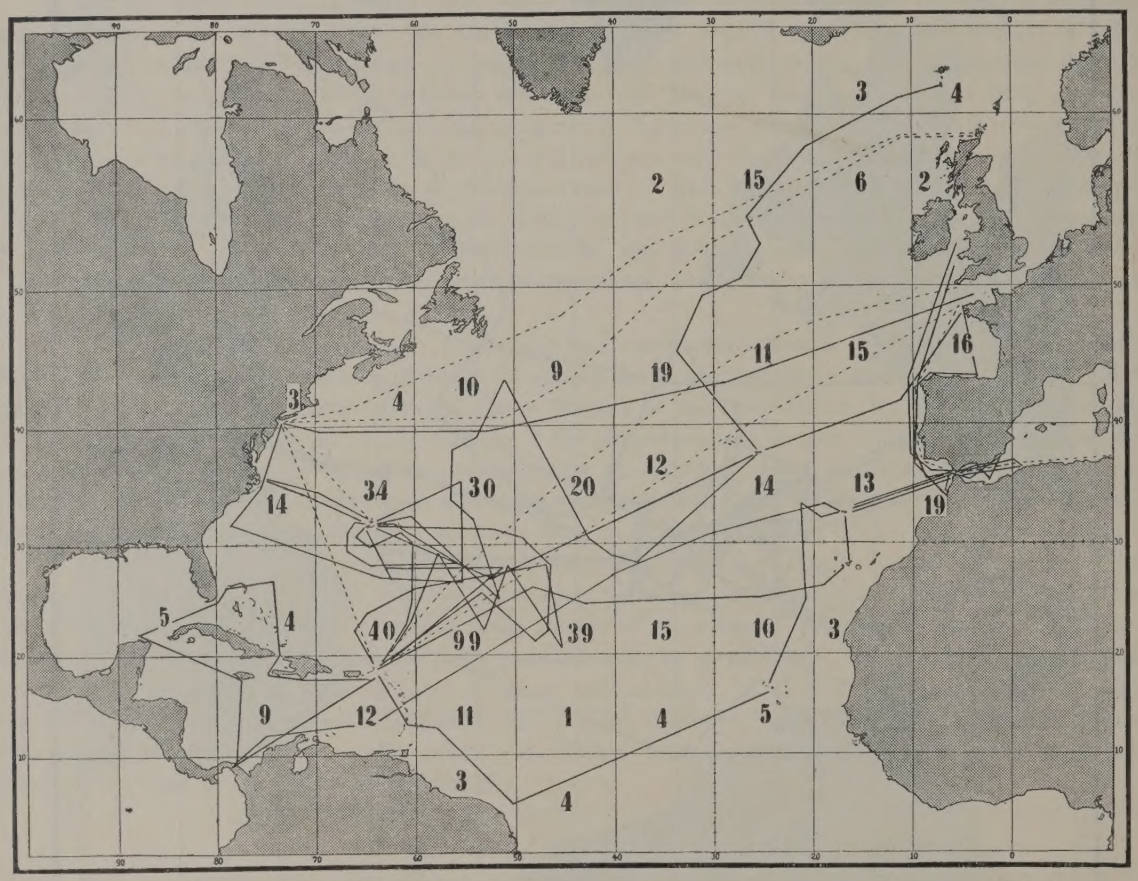


Fig. 2. Number of days during which ornithological observations were made within areas between ten degrees of longitude and ten degrees of latitude.

the east of the Bahama Islands and further on to St. Thomas round Haiti. From St. Thomas the vessel sailed to the Bermudas and on to Norfolk (U. S. A.) and thence back to the Bermudas and via the Azores to the Channel.

1928. The research steamer "Dana". From 22nd June to 25th August: From the Channel to Gibraltar and the most westerly Mediterranean and thence across the Atlantic via Madeira to Martinique and on to Panama.

1929. M/S "Java". From 1st to 6th October observations were made from Gibraltar to the Channel.

As will be seen from the chart Fig. 1, the area investigated extends from the Faroes (abt. 62° N. lat.) to off French Guiana (abt. 4° N. lat.) and east to west from the Straits of Gibraltar to the Caribbean

Sea. It will be noticed that the investigations were concentrated to a particular degree on the central area of the Atlantic, generally called the Sargasso Sea; this was owing to the fact that during the various cruises particularly comprehensive work was carried on in this portion of the Atlantic with a view to discovering the breeding places of the eel. The number of days devoted to ornithological observations was accordingly far greater in the Sargasso Sea than in other areas of the North Atlantic. This will appear from the chart, Fig. 2, where the number of observation days is marked within areas between ten degrees of longitude and ten degrees of latitude.

The available diary records comprise observations from a total of 539 days. If the Sargasso Sea proper be regarded as lying between 20° to 40° N. lat. and 40° to 70° W. long. we get, in this area, 262 observation days which amounts to 48.6 % of the aggregate number of days recorded.

As regards several species of birds, the time of year plays an essential part as to their distribution, and it will therefore be interesting to get a general idea of to what extent observations were made at different times of the year, in the various areas of the Atlantic. The table given below shows the number of observation days within areas between ten degrees of longitude and ten degrees of latitude in the summer and winter half-year respectively, the former being reckoned from the 1st April to the 30th September and the latter from the 1st October to the 31st March.

| W. long. | | 90° | 80° | 70° | 60° | 50° | 40° | 30° | 20° | 10° | 0° | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70° N. lat. | Summer | ... | ... | ... | ... | ... | ... | ... | 3 | 4 | | 7 |
| | Winter | ... | ... | ... | ... | ... | ... | ... | 0 | 0 | | 0 |
| 60° - - | Summer | ... | ... | ... | ... | ... | 1 | 14 | 4 | 1 | | 20 |
| | Winter | ... | ... | ... | ... | ... | 1 | 1 | 2 | 1 | | 5 |
| 50° - - | Summer | ... | 1 | 2 | 9 | 8 | 19 | 9 | 7 | 12 | | 67 |
| | Winter | ... | 2 | 2 | 1 | 1 | 0 | 2 | 8 | 4 | | 20 |
| 40° - - | Summer | ... | 12 | 28 | 12 | 13 | 10 | 10 | 9 | 13 | | 107 |
| | Winter | ... | 2 | 6 | 18 | 7 | 2 | 4 | 4 | 6 | | 49 |
| 30° - - | Summer | 0 | 0 | 28 | 46 | 22 | 15 | 5 | 3 | ... | | 119 |
| | Winter | 5 | 4 | 12 | 53 | 17 | 0 | 5 | 0 | ... | | 96 |
| 20° - - | Summer | ... | 2 | 5 | 6 | 0 | 0 | 0 | ... | ... | | 13 |
| | Winter | ... | 7 | 7 | 5 | 1 | 4 | 5 | ... | ... | | 29 |
| 10° - - | Summer | ... | ... | ... | 0 | 0 | ... | ... | ... | ... | | 0 |
| | Winter | ... | ... | ... | 3 | 4 | ... | ... | ... | ... | | 7 |
| 0° - - | | | | | | | | | | | | |

Of the aggregate number of 539 observation days, 333 (62 %) occur in the summer half-year and 206 in the winter half-year. North of 50° N. lat. the observations are almost entirely from the warmer time of the year, 84 % of the observation days occurring in the summer half-year. Between 40° and 50° N. lat. the observation days during the summer half-year amount to 77 %, between 30° and 40° N. lat. to 69 % and between 20° and 30° N. lat. to 55 % of the aggregate observation days within the respective degrees of latitude. Of the 49 observation days south of 20° N. lat. the majority (73 %) occurs in the winter half-year. From the above synopsis it will be seen that in the winter half-year, observations in the northern part of the Atlantic are very few in number, while in the areas between 20° and 40° N. lat. a considerable number of observation days occur in the summer as well as in the winter half-year. Particularly west of 40° W. long. we have an area which is very thoroughly investigated, the greater number of observation days being fairly equally distributed over the different times of the year.

# III. ON THE FREQUENCY OF BIRDS ON THE OPEN ATLANTIC

When cruising in the open Atlantic, the numbers of birds observed from the ship are extremely variable, and it is evident that their frequency depends, to a great extent, on where in the Atlantic one happens to be. It will therefore be interesting to study this circumstance a little more closely on a basis of the diary records we have at our disposal[1].

It will, however, at first be necessary to consider the observation material that can be used for this purpose, as, *inter alia*, it will be necessary to omit all observations made in the immediate vicinity of land. For in the case of such observations, so many circumstances intervene that, to a great extent, it is a matter of accident whether a greater or less number of birds is observed. Thus it would make all the difference in the world whether one happened to be in the vicinity of a coast where there were colonies of breeding birds, or in the neighbourhood of a coast practically devoid of birds. In order, as far as possible, to confine ourselves to the observation of open sea birds, we will in the following restrict ourselves to accepting observations made at a distance of at least fifty miles from the nearest land. We shall furthermore make use of observations only of such birds as may be said to be indigenous to the open sea and thus leave out all land and typically coast birds. Thus, practically speaking, it is only the web-footed birds that are involved.

It will be necessary to give some information regarding the collection of observation material.

When making the daily observations the number of the birds observed was, as far as practicable, noted and it is these figures that form the basis of the following description. In many instances the numbers counted could be given only approximately. This was the case when birds were seen in flocks. In such circumstances only the lowest number of the birds observed is taken into consideration. When the diary gives a flock of, for instance, 20 to 25 birds the number taken is 20, a flock of 10 to 15 birds as 10 and so on, in other words that the figures given must be looked upon as minimum numbers. Several species of birds may follow the ship for a considerable time and often in varying numbers and in such cases it is, of course, not possible to estimate the exact number. I therefore adopted the following method. Birds that kept following the ship all day were counted only once and the largest number seen together during the course the day was noted as the number of these birds. When it was a question of a single species seen at intervals in the course of the day there was of course a possibility of the same individual being counted several times during that day. As far as possible I, of course, tried to avoid anything of the kind, but, particularly where repeated observations of the same species were concerned, it was difficult, even approximately, to determine the number of individuals. If a bird of a certain species, for instance, appeared about the ship several times during the day, I always considered it as the same individual, provided there had not been an interval of six hours between each of the observations.

To get an idea of the frequency of birds in different parts of the Atlantic the number observed per day is first entered on a chart, then the average figure is calculated for areas of ten degrees of longitude and ten degrees of latitude. In these calculations fractions must necessarily often appear but these are in all cases rejected. The result of the calculations will be seen on the chart (Fig. 3) below, where the figures given must be understood thus that, for instance, the figure 1 means that the average number of birds per day lies between 1 and 2, the figure 2, that the average number lies between 2 and 3 and so on.

As already mentioned the average figures given must be looked upon only as minimum statements. This is particularly the case where birds are observed in large numbers. On the chart the average figures in such areas have therefore the sign $>$ placed before them and this indicates that the entry,

[1] Regarding the investigation of the frequency of birds in the open Atlantic some preliminary reports have previously been published (JESPERSEN 1924 and 1929).

> 13, means that the average of birds observed per day must be reckoned as at least thirteen. In many instances the actual number would be very considerably larger.

It will be seen from the chart that the frequency of birds is greatest near land which is very natural. North of 50° N. lat. we have the greatest number in the waters around the Faroes and Iceland, and the most predominant species of birds, in a quantitative respect, here are Fulmars (*Fulmarus glacialis*) Kittiwakes (*Rissa tridactyla*) Skuas (*Stercorarius*) and Shearwaters (*Puffinus*). The number of birds decre-

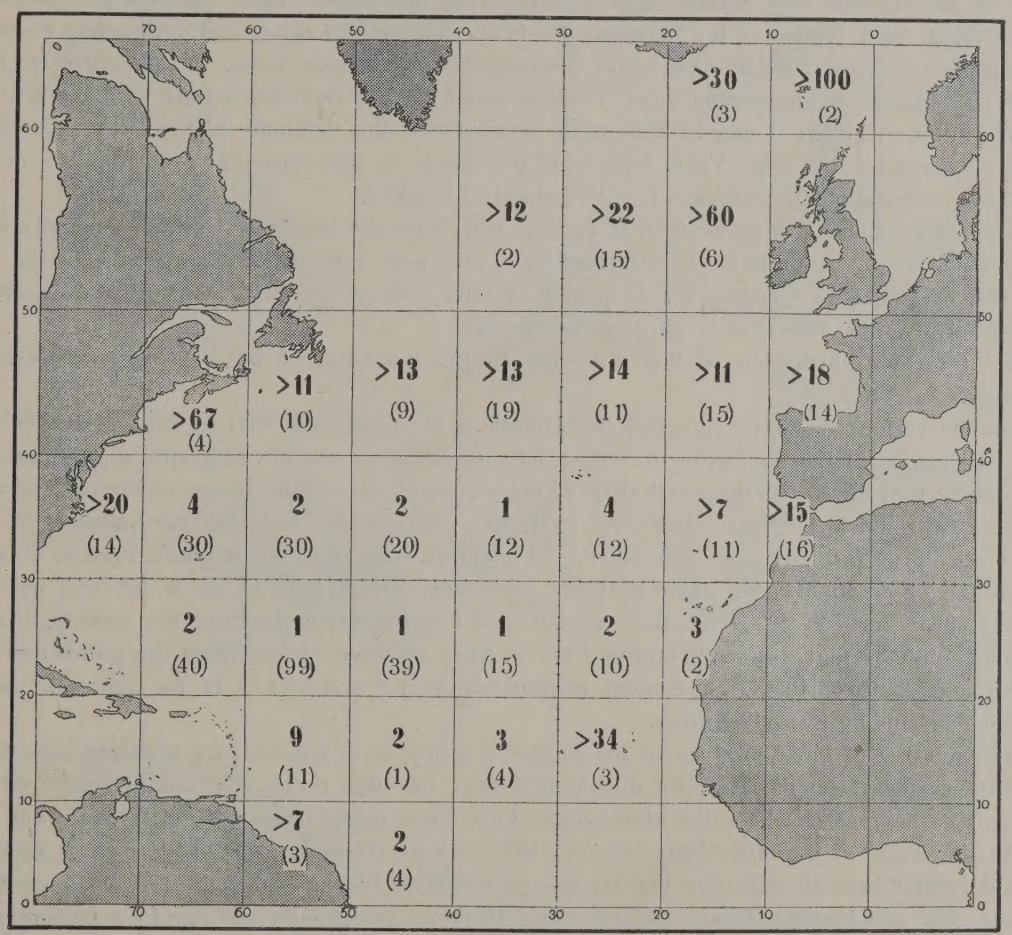


Fig. 3. The average number of birds observed per day within areas of ten degrees of longitude and ten degrees of latitude. The figures in brackets indicate the number of observation days within the respective areas.

ases considerably as we get further away from land. Between 40° and 50° N. lat. there is the greatest number likewise nearest land, and that on both sides of the Atlantic, but on the entire stretch across the ocean quite considerable numbers of birds are to be met with. Those that occur here most generally are Kittiwakes, Skuas and Shearwaters, but besides these, various species of Storm Petrels (*Hydrobatidæ*) particularly *Oceanites oceanites* appear in large numbers in the summer half-year. The particularly large average figure, > 67, south of Nova Scotia is thus due chiefly to a very numerous occurrence of this storm petrel in the summer months. On looking at average figures given between 30° and 40° N. lat. it will be noticed that the frequency of birds everywhere is considerably less than in the northern areas and this applies in particular to the more central parts of the Atlantic. In the area between the Azores

and Bermudas the number thus lies between one and four birds per day. This very low figure is typical of the entire Sargasso Sea, as is shown most distinctly by the average figures between 20° and 30° N. lat. In the area between 20° and 40° N. lat. and between 40° and 70° W. long., which embraces the Sargasso Sea proper, such low figures as 1 to 2 are to be met with except in the area that encompasses the Bermudas, where the average figure is 4 birds per day; this relatively higher figure being presumably due to the presence of these islands. As the number of observation days is particularly large in the Sargasso Sea area we are, for this very reason, safe in considering the average figure for this place as distinctly representative. A bird typical of the Sargasso Sea is the Tropic-bird (particularly *Phaethon lepturus*) but various species of Storm Petrels, Skuas and Shearwaters also appear there, though sparsely. South of 20° N. lat. the number of observation days is rather small, we can therefore hardly assign much value to the average numbers given; it merely remains to be said that the strikingly high average figures for the area that encompasses the Cape Verde Islands is due alone to the appearance of a species of tern, in flocks, which, unfortunately, could not be more closely identified.

Thus, from the above particulars, it appears clear that the Sargasso Sea and, generally speaking, the warmer part of the Atlantic is characterized by a very poor avifauna as compared with the northern areas of this ocean. If we consider the frequency of birds out on the open sea, north and south of 40° N. lat. respectively, this difference is particularly striking.

As a further illustration of this difference in the frequency of birds we will consider another circumstance.

On the various research cruises in the Atlantic it often occurred that no birds whatever were observed in the course of the day. Now it would be interesting to see the geographical position on such negative observation days. On the chart (Fig. 4) below, which shows the routes of the cruises with M/S "Margrethe" 1913 and M/S "Dana" 1920 and 1921, the positions for each day are indicated by a mark and the black dots show our position on the days no birds were observed on these cruises. It is obvious that almost all observation days, when no birds were seen, occur south of 40° N. lat. and nearly all in the Sargasso Sea. North of 40° N. lat. there is only one negative day while there are seventy three during observations south of that degree of latitude. On a basis of these observations the number of negative days north and south of 40° N. lat. amount respectively to 1.3 and 28.1 % of the aggregate number of observation days in the respective areas.

The number of birds observed in the course of a day is, of course, to a certain degree dependant on the distance the vessel has travelled during that day. For this reason the number observed per day will, as a rule, be greater where the observations have been made from a steamer than from a sailing vessel. On the cruise of the M/S "Margrethe" in 1913, which extended from the Faroes to south of the Azores and further in a zig-zag over the Atlantic to the West Indies, sail was exclusively employed on the voyage. The observations from this cruise are therefore particularly adapted to a comparison. The aggregate number of observation days on this cruise amount to 147. Of these 46 occur north of 40° N. lat. and 101 south of that latitude. Of the 46 observation days north of 40° N. lat. there was only a single day (2.2 %) on which no birds were seen, while south of 40° N. lat. there were 27 such negative days (26.7 %). On the single negative day, north of 40° N. lat., the weather was bad (windforce 8) so it is probable that the state of the weather was responsible for no birds being observed that day.

In this connection it will be of interest to state that, on the Danish cruises, the longest period during which no birds were seen, was four days. Occasionally no birds were seen for three days at a time, repeatedly for two days, and otherwise only a single day at a time. The longest periods during which no birds were seen all occurred in the Sargasso Sea and everywhere in areas far distant from land. It is however no unique experience to be in the Sargasso Sea for a long time without seeing the least sign of bird life. Thus the German plankton expedition of 1889 remained there for seventeen days during which period only a single bird was observed viz. a Tropic-bird (Fr. Dahl 1892). In 1911 Professor H. Lohmann

(1912) made ornithological observations during the voyage of the German vessel "Deutschland" from Bremerhaven to Buenos Ayres. On the stretch from the Channel to the Azores, five was the average number of birds observed per day. The course of the vessel from the Azores was at first southerly to 25° N. lat. then westward to 45° W. long. and from there again south to 10° N. lat. On the voyage southward from the Azores, which extended over 26 days, birds were seen during six days only and then none

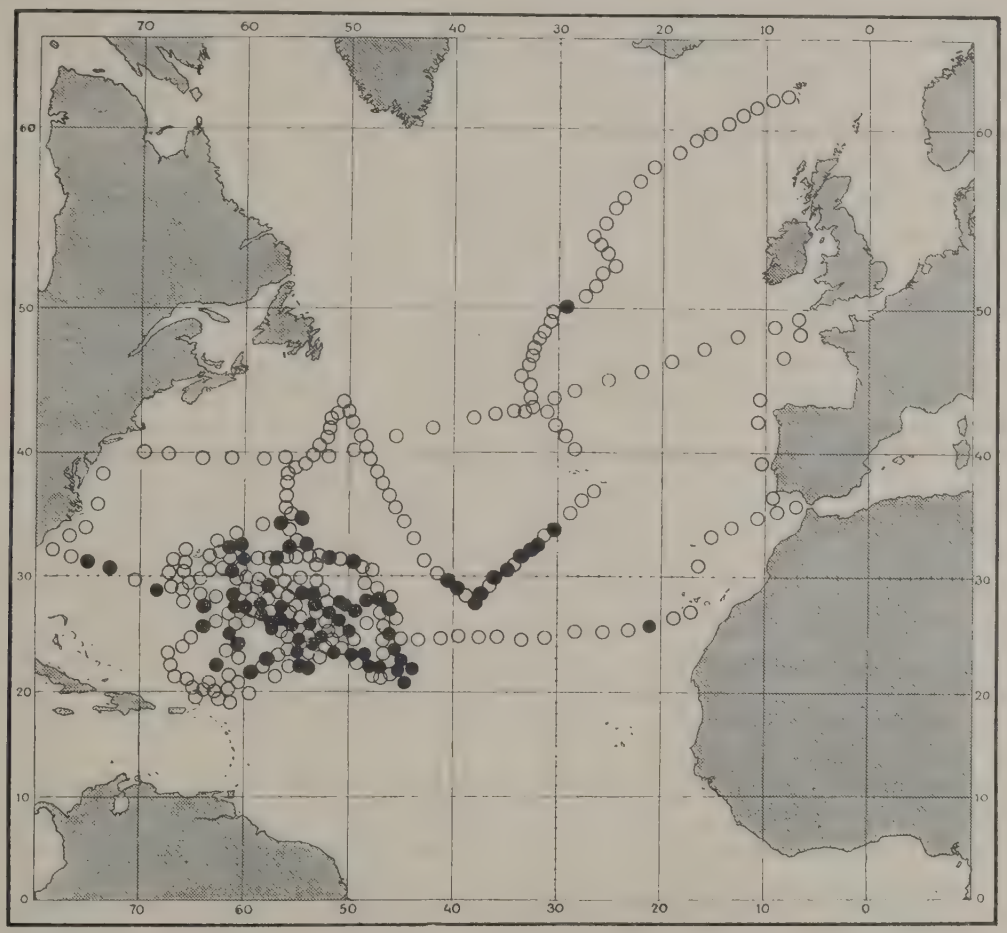


Fig. 4. Routes of the M/S "Margrethe" 1913 and M/S "Dana" 1920 and 1921. The black dots show the days when no birds were observed from the vessels during these cruises.

but Tropic-birds. On five of these days only one bird a day was seen and on one day two specimens were observed. It will thus be seen that the number of birds on the whole of this route which traverses the eastern portion of the Sargasso Sea, was extremely sparse.

The obvious question that now arises is: why does the number of birds vary so much over the different parts of the Atlantic and particularly is so sparse in the Sargasso Sea?

As a general rule, it holds good that the number of birds decreases more and more the further we move from land but this alone does not explain the poor avifauna in the Sargasso Sea. There are, to be sure, many places in this sea where the distance from land is very great, but this is also the case in the central parts of the Atlantic between 40° and 50° N. lat. where the number of birds is so many times greater than in the Sargasso Sea. The greater or lesser distance from land can thus hardly be the actual

reason for the sparse bird life of the Sargasso Sea but the explanation must rather be sought in the relatively insignificant quantity of food found in this area of the sea.

As is generally known, large quantities of sea weed (*Sargassum*) drift about on the surface of the Sargasso Sea and at the outset one would be inclined to suppose that the rich animal life (fishes, crustaceans, molluscs etc.) in the Sargasso sea weed might present conditions for a rich bird life. It is, however, hardly probable that the particular fauna existing in the Sargasso sea weed play any prominent part as nourishment for the birds in that sea area. During the months we stayed in the Sargasso Sea I rather often had an opportunity of investigating the contents of several birds' stomachs and I never found the least trace of the fauna of fish or invertebrates special to the Sargasso sea weed. Stomach analyses have on the contrary shown that the birds out there — at any rate to a paramount degree — live on flying fish and squids. This seems to suggest that the birds in the Sargasso Sea utilise to, at any rate, but a slight extent the special sea weed fauna as food but — as in other sea areas — live in most cases on fish, squids and other animals that move about freely in the water.

It will therefore, in this connection, be interesting to enquire how the Sargasso Sea compares with the northern areas of the Atlantic in respect of the quantity of such larger plankton organisms (macroplankton) that might possibly serve as nourishment for the birds out on the ocean. On the Danish research cruises in the Atlantic a long series of investigations were made as to the quantity of macroplankton in all the investigated parts of the ocean and these researches give a fairly good idea of the distribution of plankton.

The investigations referred to were conducted in this manner: a two-meter stramin-net was towed through the water at various depths[1]. In this connection it is of interest to consider only the hauls made in the uppermost layers of water. For every single haul the volume of the plankton fished is so converted that an estimate is formed of the quantity fished up at a haul, per hour. In this way a large number of results as to volume are collected, which being entered on a chart give, roughly, a picture of the quantity of plankton in the different areas of the Atlantic. To facilitate a survey the average volume of plankton is reckoned within areas of ten degrees of longitude and ten degrees of latitude as shown on the chart (Fig. 5) below, where the large figures give the average volume (in ccm) fished at a haul per hour, in the uppermost layers of water, and the smaller figures show the number of hauls made in the different areas.

It is evident from the chart, that the quantity of plankton differs extremely in the various parts of the Atlantic. The greatest volumes are found in the vicinity of the coasts while the quantity decreases out towards the central parts of the ocean. In the more northern areas of the Atlantic, to wit north of 40° N. lat., far larger quantities are found than south of that latitude. In the parts of the Atlantic that embrace the Sargasso Sea, we encounter strikingly smaller quantities of plankton. Unfortunately but relatively few observations from the area between 40° and 50° N. lat. are available, but everything goes to show that the quantity of plankton in that area is at least ten times as great as in the central part of the Sargasso Sea.

From what has already been stated, it would appear that the parts of the Atlantic, where large quantities of plankton are found, coincide in all essentials with the areas where the rich avifauna occurs, and in those parts where the quantity of plankton is very small, as for instance in the Sargasso Sea, we encounter very few birds. There seems thus to be a certain state of dependence between the quantity of plankton and number of birds in the various areas of the Atlantic.

When one considers that the plankton of the ocean — more or less directly — serves as food for birds out at sea it can be quite well understood that the richest bird life develops in the areas where the greatest quantity of food is to be found in the sea. Of course only the larger plankton organisms such as fish, crustaceans, squids, worms etc. serve as food for the ocean birds but purely quantitatively

[1] A more detailed description of the plankton investigations will be found in Jespersen (1923).

the crustacea undoubtedly play the most important part. Particularly in the northern parts of the Atlantic where we have the great bulk of plankton, enormous quantities of copepods, amphipods and euphausiids occur, as is well known. Some birds live directly on these small crustacea, thus the Kittiwake (*Rissa tridactyla*) which, around Iceland and the Faroes, is often to be met with its crop and stomach quite full of these crustaceans. The importance of these plankton organisms as nourishment for the birds is,

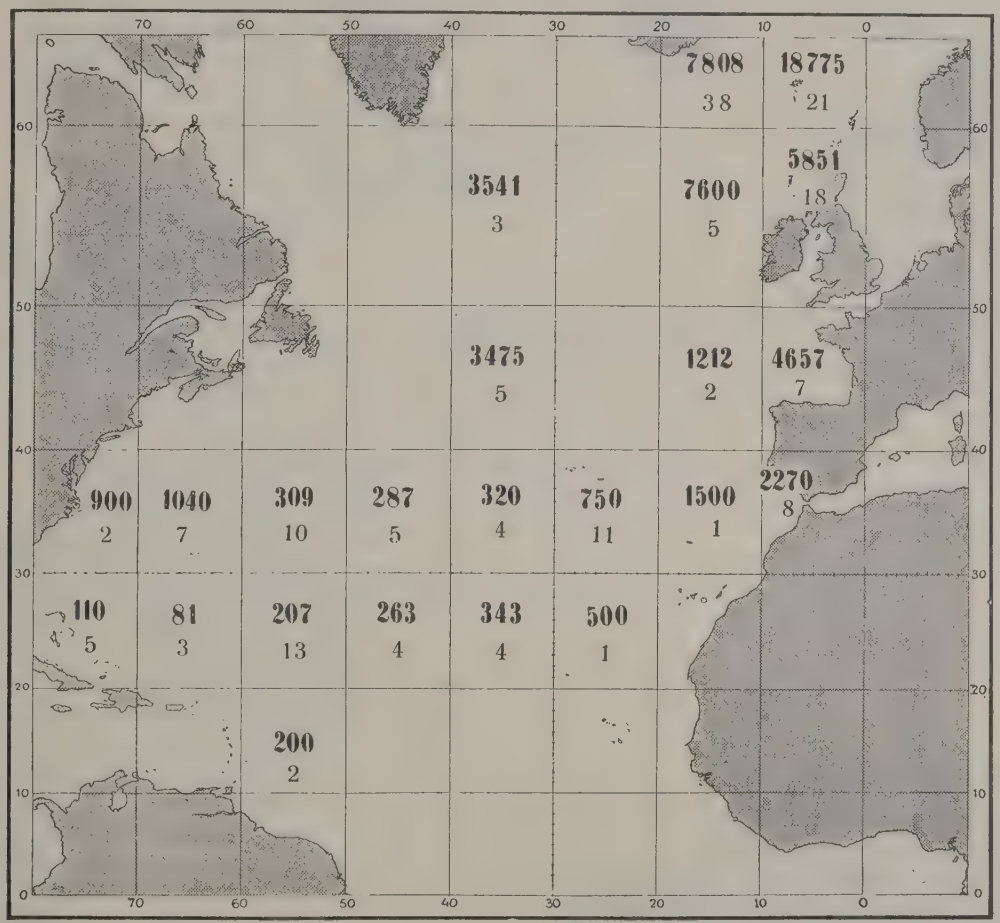


Fig. 5. The average volume (in ccm.) of macroplankton in the upper layers of water. The large figures give the volume and the smaller figures the number of hauls in the respective areas of ten degrees of longitude and ten degrees of latitude.

however, often more indirect. Many of the birds that frequent the ocean preferably seek their nourishment among fish and fry and where we have an abundance of fish there is therefore a considerable bird life as well. Now the fact is that many fish live on the crustaceans mentioned and where these are abundant there are therefore often great numbers of fish. A multitudinous occurrence of these plankton organisms thus creates conditions for a great abundance of fish and this again, possibilities for a numerous bird population. It will thus be seen that whether the birds live directly on the plankton animals or for the most part exist on fish the bird life must, ultimately, be dependent on the quantity of plankton found in the sea.

The teeming bird life found on the bird haunted cliffs along the coasts of the northern seas is doubtless contingent upon the large quantities of plankton and the consequent abundance of fish found

in many of these sea areas. The birds are here represented by comparatively few species, but most of these occur in an enormous number of individuals and, generally, the number of birds in tropical and sub-tropical waters is not to be compared with the abundance of birds one encounters in many places in the North Atlantic sea areas.

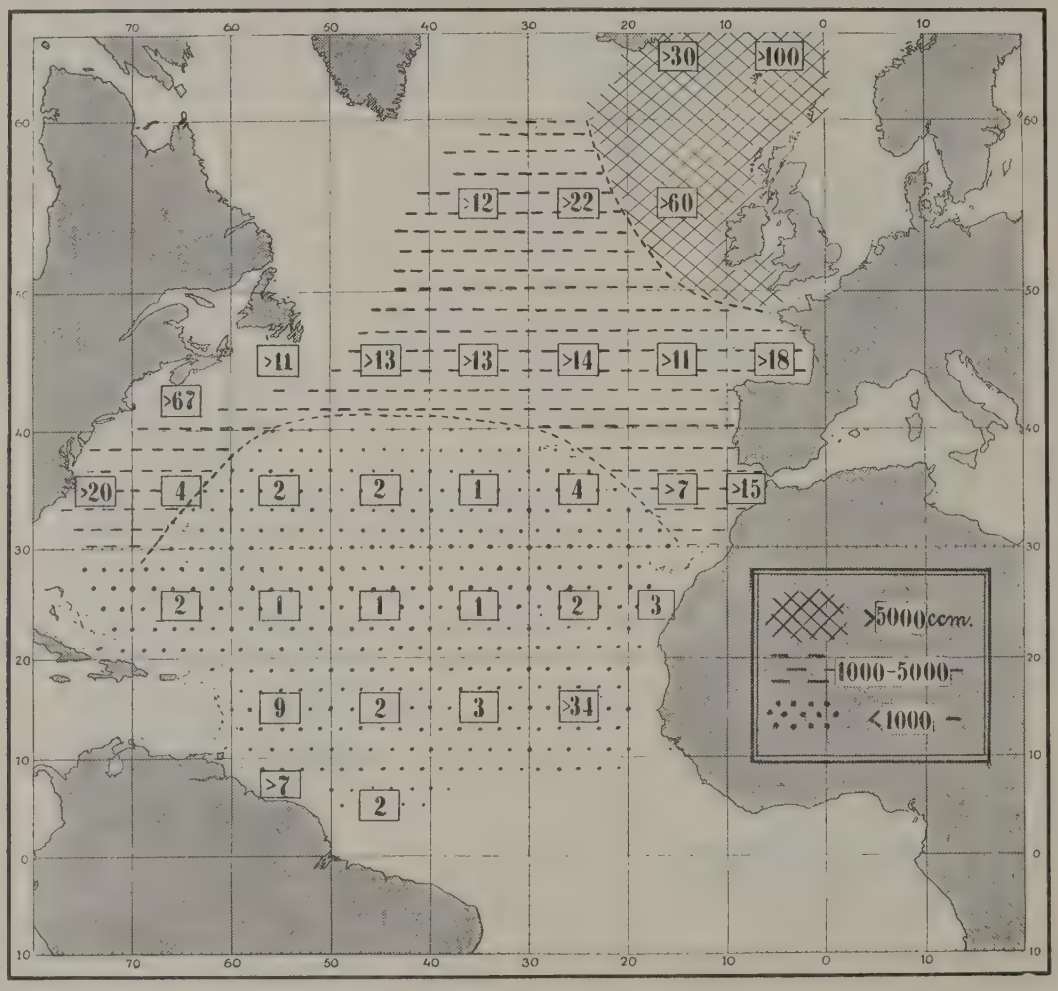


Fig. 6. Showing the quantities of macroplankton (in ccm.) and the average number of birds observed per day in the various areas of the North Atlantic.

To further illustrate the relation between the quantity of macroplankton and the number of birds on the open Atlantic we will consider the chart (Fig. 6) above.

Three different signatures indicate the areas of the Atlantic where the quantity of plankton is less than 1000 ccm., between 1000 and 5000 ccm. and greater than 5000 ccm. per haul, per hour, in the upper layers of water. Furthermore there are figures indicating how many birds were observed per day within areas of 10 degrees of longitude and 10 degrees of latitude. The curves showing the distribution of the quantities of plankton do not claim to be exactly correct but give a rough idea of where it is scanty and where abundant.

It appears from the chart that the part of the Atlantic where we have the smallest quantity of plankton, to wit primarily the Sargasso Sea, coincides in all essentials with the area where the smallest number of birds were observed. As soon as we come up into the Gulfstream area with its considerably larger quantity of plankton, the number of birds increases greatly. In this area we get at least ten times as many birds per day as in the central part of the Sargasso Sea for we must remember that the figures for the Gulfstream are minimum statements.

In the north eastern corner of the Atlantic, between Great Britain and Iceland and around the Faroes, we have the largest quantities of plankton and, in conformity with this, a very rich bird life.

The complete picture of bird life on the open Atlantic reveals therefore, that in the northern parts we have a far richer bird life than in the tropical and subtropical areas and the essential cause of this state of things must certainly be sought in the comparatively larger quantities of plankton found in the northern than in the tropical areas of that ocean.

## IV. A SYSTEMATIC SURVEY OF THE SPECIES OF BIRDS OBSERVED

In the following survey the observations of each separate species of birds are dealt with. In several cases it has not been possible to determine the various species with certainty, it has therefore been necessary to give the description a more summary character. The species it was possible to indentify have therefore been the subject of a more thorough discussion.

It is intended, on a basis of the available observation material, to give, as far as possible, a picture of the distribution of the various species in the north Atlantic. As a rule only the positions cited are given in degrees, it being considered unnecessary to state more exactly the position of the birds.

In this paper but little notice has been taken of the somewhat comprehensive literature, of a more or less scattered character, which is available regarding ornithological observations in the north Atlantic[1].

### Order: Tubinares.

#### Family *Procellariidæ.*

In quite a number of instances it has not been possible to determine with certainty the various species of the family *Puffinus*, and in the following the distribution of each single species will not therefore be made the subject of a more detailed description, as the relatively few determinations, as to species, available would hardly give even a moderately perfect picture of the distribution of the various species. In contradistinction to so many other ocean birds, the species of the family *Puffinus* are only very occasionally seen in the immediate vicinity of the vessel as they are not interested in the ship but, as a rule, may be seen, on their stiff wings, flying low over the waves at a considerable distance from it.

##### *Puffinus gravis* (O'Reilly).

This species which is known only as breeding at a single locality viz. on the Inaccessible Island, in the Tristan da Cunha group in the most southern part of the South Atlantic, is often seen during the summer half-year in the North Atlantic. It frequently appears there in flocks and very often these flocks consist of fifty to a hundred birds or even more. It is observed in the greatest numbers over the open sea to the west of Great Britain and the Faroes also off Iceland. Thus several flocks, and some of them large ones, were seen in July—August 1913 on the stretch from the Faroes to the Azores and in August

[1] The first Danish investigator who took up the problem of distribution of birds in the North Atlantic was O. Helms (Helms 1897), who has published the ornithological observations on four voyages from Denmark to West-Greenland.

1920 across the Atlantic from New York to the Channel, furthermore flocks were repeatedly seen by the author, in the summer, during his voyages from Denmark to the Faroes and Iceland.

*Puffinus kuhli* (Boie).

In many instances it has not been possible to distinguish with certainty this species from the foregoing but its distribution in the North Atlantic hardly stretches appreciably north, outside of the Channel. It is very generally met with in the Atlantic west of Portugal and also in the waters around the Azores, Madeira and the Canary Islands. It is also said to breed on all these islands and on the Cape Verde Islands as well.

*Puffinus griseus* (Gmel.).

Like those of the *Puffinus gravis* the breeding places of this species are found exclusively in the southern hemisphere and like that species, when not breeding it roams far around and is very commonly to be met with during the summer of the northern hemisphere in the North Atlantic, where it may be observed right up to the Faroes. A specimen which was shot from a flock N. N. W. of the Azores (43° N. lat.—31° W. long.) on the 13th Aug. 1913, had indeterminable little fish in its stomach.

*Puffinus puffinus* (Brünn.).

Along the European coasts of the Atlantic the *Puffinus puffinus* is generally the most frequent species of Shearwater, but then it breeds over a wide area viz. from the Westmanna Islands, south of Iceland over the Faroes, Great Britain and Brittany down to the Azores and Madeira. Particularly in the Atlantic north of 40° N. lat. it is generally met with but occurs in far greater numbers in the east than in the west of this area of the ocean. The stomach analysis of individual specimens of this species, shot out on the open sea to the west of Ireland in the summer of 1913, gave as a result some small cuttle fish and remains of fish.

*Puffinus assimilis* Gould.

This species which has rather a characteristic flight, with rapid strokes of the wing, is somewhat frequently seen out on the Atlantic, but it is far more numerous in the western than in the eastern areas of this ocean. It doesn't seem to roam far from the breeding grounds. These, in the eastern area, are Madeira, Salvage Islands, the Canary Islands and the Cape Verde Islands; and in the western area there are breeding grounds on the Bermudas, Bahamas Islands and several places in the West Indies. One of this species was shot on the 4th April 1930 north of Madeira and it appears somewhat generally in the Sargasso Sea though chiefly in the vicinity of the Bermudas. As the species varies somewhat in appearance, no less than three subspecies have been described from the northern Atlantic.

*Fulmarus glacialis* (L.).

The fulmar is one of the most numerous and most characteristic bird species in the northern part of the Atlantic. It almost always follows vessels on the route to Iceland and Greenland and flocks of ten to twenty birds fly together in the wake of ship. Its flight is characteristic, the bird makes a few short strokes with its wings and then, with wings outstretched, glides for a long way through the air, low over the waves. Now and then some of the birds rest for a moment on the water, but otherwise they follow the vessel stedfastly from early morning till late in the evening and pounce on all the refuse thrown from the ship.

During the research cruises, when hydrographical investigations were being carried out and the vessel lay still out on the sea, the fulmars often collected in flocks of twenty or more around the ship. First they settled on the water, a little distance from the ship, and then, swimming, they gradually approached closer and closer to it. Often they grew so confident that they would come right under the

stern of the vessel and there greedily devour all the refuse thrown from the ship. They frequently fought over the food and when really hungry they swam about restlessly uttering a peculiar quacking cry. Several times it was observed how the fulmars were able to dive from the surface after a morsal that was sinking in the water.

The seamen on board the M/S "Margrethe" indulged in the, what must be termed, very impleasant sport of catching the fulmars with a hook baited with a piece of pork. It was surprising to see how the same bird allowed itself to be caught repeatedly. One specimen, which was marked with a bit of string tied round one of its legs, allowed itself to be captured as many as four times in the course of an afternoon. As the hook employed was a bent pin the bird was but slightly injured by swallowing the bait. Up on the deck these birds could move about only with the greatest difficulty and they were unable to start flying from it. When they had stayed a moment on deck they often had an attack of violent vomiting and fell down in a state of stupor. They evidently couldn't stand the rocking of the vessel.

As regards the fulmar's food HAGERUP (O. HAGERUP 1926), among others, has carried out investigations which show that the most important article of food, in a quantative respect, is small crustacea such as copepods, euphausiids and amphipods which are found in such enormous quantities in the northern areas of the Atlantic.

Fig. 7. Fulmar (*Fulmarus glacialis*). The dots give the positions where the fulmars were observed. The Roman figures indicate the months in which these observations were made. The continuous lines indicate the routes of the research vessels and the dotted lines those of passenger boats.

The fulmar breeds along the northern coasts of the Atlantic. From Greenland, Spitzbergen and Iceland the breeding grounds stretch towards the south to the Faroes, Hebrides, Shetland and Orkney Islands and Scotland. During recent years the fulmar has extended its breeding area very considerably. Thus breeding grounds have lately been found in Ireland (LIDNER 1919) on the west coast of England (HARTERT 1910—22, LIDNER 1922) and also at a single locality in Norway (JOHNSEN 1924).

The observations from the Danish expeditions in the Atlantic give quite a good picture of the fulmar's distribution over the open sea and, particularly, information as to the south limit for the occurrence of the species. On the annexed chart (Fig. 7) the positions where fulmars were observed are shown.

On a cruise from the Faroes to the Azores (July—August 1913) the fulmar was observed almost daily until about 50° N. lat.—30° W. long. In August (1920) there was another trip from New York to the Channel; the fulmar first made its appearance from about 20° W. long. to 9° W. long. The most southerly position lay at about 48° N. lat. From these observations it appears that the southern limit for the occurrence of the fulmar during the summer lies about 48°—50° N. lat. In the winter half-year there was a trip from St. Thomas to the Channel (March 1914). The first fulmar was seen a little north of the Azores and after that daily until the western part of the Channel. The southern limit for the distribution of the fulmar in the Atlantic, during the winter, may therefore be fixed at about 40° N. lat. It appears from these observations that the fulmar travels considerably further south in the North Atlantic during the winter than during the summer, as the south limit in summer lies at about 48°—50° N. lat. and in winter at about 40° N. lat.

Owing to sufficient observation material not being available from the western part of the Atlantic, these limits may be said to apply only to the eastern areas of this ocean. CLEVELAND (1922) mentions,

however, that the fulmar on the east coast of America seldom goes further south than Massachusetts (about 43° N. lat.). When the "Margrethe" in September 1913 arrived off Newfoundland we saw fulmars immediately we got into the cold Labrador stream which here turns in a south-westerly direction across the Newfoundland bank. Fulmars were seen on the 20th Sept. at about 43° N. lat.—50° W. long. and on the 21st Sept. at about 43° N. lat.—52° W. long. On the steamer routes from New York to the north of Scotland, fulmars are observed daily during the winter (December), the whole way across the Atlantic. On the other hand, in the month of July, the fulmar is not seen on this stretch until about 48° N. lat.—38° W. long. is reached.

*Bulweria Bulweri* (Jard. and Selby).

This species which is easily recognisable by its dark colour and insignificant size was, on the Danish cruises, but very rarely observed in the south-eastern part of the North Atlantic viz. in the waters around Madeira and the Canary Islands. It is emphatically a twilight bird. I for instance have seen it out at sea only at sunset or in the gloaming. What has, moreover, been characteristic of its habits is, that I have never seen more than a single bird at a time. When darkness was gradually falling, a single specimen of this species would come skimming low, in rapid flight, around the ship. The above stated observation area coincides with the area where it is known as a breeding bird. According to the literature on the subject (Godman 1908—09, Loomis 1918, Witherby 1922) it is said, in the Atlantic for instance, to breed only in the south-eastern part viz. on Madeira, the Salvage Islands, the Canary Islands, the Cape Verde Islands and possibly also on the Azores.

*Pterodroma mollis* (Gould).

Once in a way small flocks of shearwaters were observed in the waters around Madeira, at a long distance from our vessel. These, in all probability belonged to the above species, the breeding places of which, in the North Atlantic, are known to be Madeira and the Cape Verde Islands.

## Family ***Hydrobatidæ.***

Of the five Atlantic species belonging to this family, four viz. *Hydrobates pelagicus, Oceanodroma castro, Oceanodroma leucorrhoa* and *Oceanites oceanicus* have such a uniform appearance viz. the dark colour of the body with the white patch on the rump, that the author experienced the greatest difficulty in identifying the different species when seen flying over the water. The comparatively few specific determinations, of any certainty, that we have succeeding in making, tell us very little about the distribution of each single species and these birds must therefore be discussed in quite a summary manner. We will, however, to begin with, give a brief account of where each of the species is found to breed and also mention a few facts as to their distribution.

*Hydrobates pelagicus* (L.).

Occur particularly in the eastern part of the North Atlantic; of the known breeding grounds may be named the Faroes, the British Isles and Brittany.

*Oceanodroma castro* (Harc.).

Like the foregoing species this one lives particularly in the eastern part of the North Atlantic but has a far more southerly distribution as it is found breeding only on the Azores, Madeira, the Salvage Islands and the Cape Verde Islands.

*Oceanodroma leucorrhoa* (Vieill.).

In contrast to the other species of this family the *Oceanodroma leucorrhoa* has a large breeding area in the North Atlantic. It is, for instance, found breeding both on the North American as well as the

North European coasts. In America it breeds on the east coast of Canada from Labrador to Maine and possibly in Greenland. On the Westmanna Islands south of Iceland there are large breeding colonies and furthermore it breeds on the Hebrides, St. Kilda and on the rocky islands on the west coast of Ireland while, strangely enough, the species has not yet been recorded as a breeding bird on the Faroes.

*Oceanites oceanicus* (Gmel.).

Of all storm petrels this species is undoubtedly the most numerous out on the open Atlantic but yet only in the summer half-year, as it migrates during the winter. Its breeding grounds are known only in the southern hemisphere viz. South Georgia, South Shetland, South Orkney, islands off Cape Horn, Kerguelen Land and on other antarctic and sub-antarctic islands. It appears in particularly large numbers, during the summer of the northern hemisphere, in the Gulfstream region off the east coast of the U. S. A. and south of Newfoundland and at any rate by far the greatest number in these multitudes of storm petrels which, during the summer, were observed by the Danish expeditions in these waters, belonged undoubtedly to this species (*vide* Fig. 9, p. 20).

---

Even though, as stated, it is not possible to more definitely distinguish the above mentioned four species in the available observation material, it will, however, be of interest to state various circumstances regarding the distribution of these storm petrels.

The following charts (Fig. 8 and Fig. 9) show the positions where storm petrels were observed in the winter and summer respectively. Under the heading of winter observations are included all observations made between the middle of November and the end of March and under summer observations those made between the middle of May and the end of September. The encircled dots indicate where storm petrels were seen in the greatest numbers i. e. more than five birds at a time.

It will be noticed that in the Gulfstream region storm petrels were observed in particularly large numbers and, as already mentioned, there is hardly any doubt that, at any rate, a large majority of these, which were often seen in flocks of anything up to fifty birds, belonged to the species *Oceanites oceanicus*. In the Sargasso Sea storm petrels were seen only in small numbers during the summer. In the winter half-year, on the contrary, they were not observed at all north of about 30° N. lat. which is doubtless due to the fact that *Oceanites oceanicus* which are so common in this area during the summer, betake themselves during that time of the year to the southern hemisphere, in the vicinity of their breeding grounds. Unfortunately the storm petrels observed in the Sargasso Sea during the winter could not possibly be identified.

The charts figs. 8 and 9, as stated, show only the winter observations reckoned from the middle of November to the end of March and the summer observations from the middle of May to the end of September. We have a series of observations made by Captain G. Hansen from the M/S "Dana" in the spring of 1921 (25th Feb. to 2nd May) and it will be interesting to consider these a little more closely. The chart fig. 10 (p. 21) gives the positions of the route on this cruise in the Sargasso Sea, which started from and finished at St. Thomas in the West Indies, and the days when storm petrels were seen are marked with black dots.

During the first part of the cruise viz. from the 25th Feb. to the 31st March, storm petrels were observed on three days only and then only a single bird at a time. During the following eight days viz. from the 1st to the 8th April storm petrels were seen on two days, from the 9th to the 16th on five days, from the 17th to the 24th on five days and from the 25th April to the 2nd May on eight days. The number of birds seen also increase steadily during the last two or three weeks of the cruise. There can thus be hardly any doubt that the great increase in the number of storm petrels during April is due

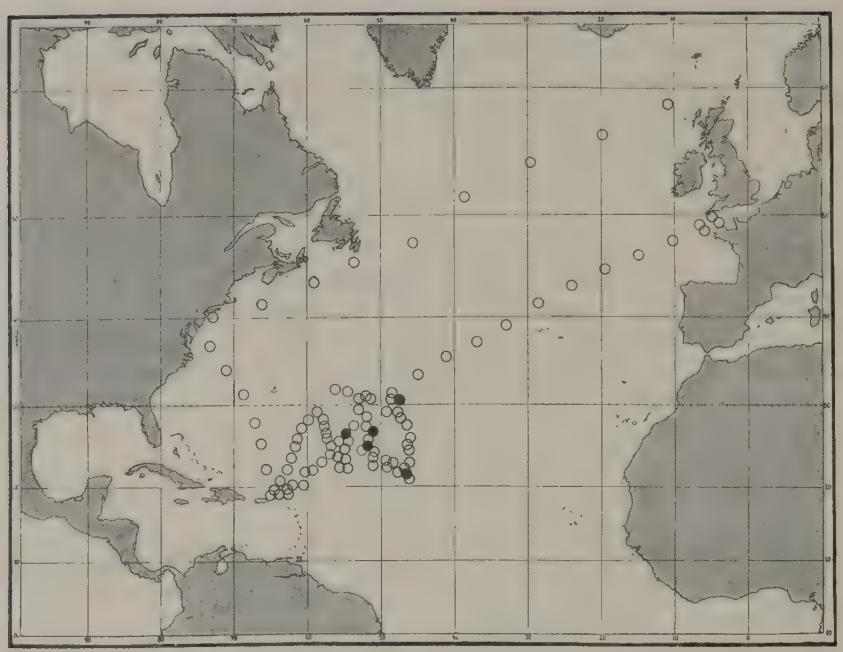

Fig. 8. Observations of storm petrels during the winter in the North Atlantic. In none of the positions were there more than one or two birds observed.

Fig. 9. Observations of storm petrels during the summer in the North Atlantic. The encircled dots indicate where more than five birds were seen at a time.

LIBRARY
FISH & WILDLIFE SERVICE
PACIFIC OCEANIC FISHERY
INVESTIGATIONS



to an influx of these birds from some other place, and though Captain Hansen was unable to distinguish the species of these birds, everything points to their having been especially the species *Oceanites oceanicus* which in the spring were on their way, migrating from the southern hemisphere to the distant North Atlantic, there to spend the summer.

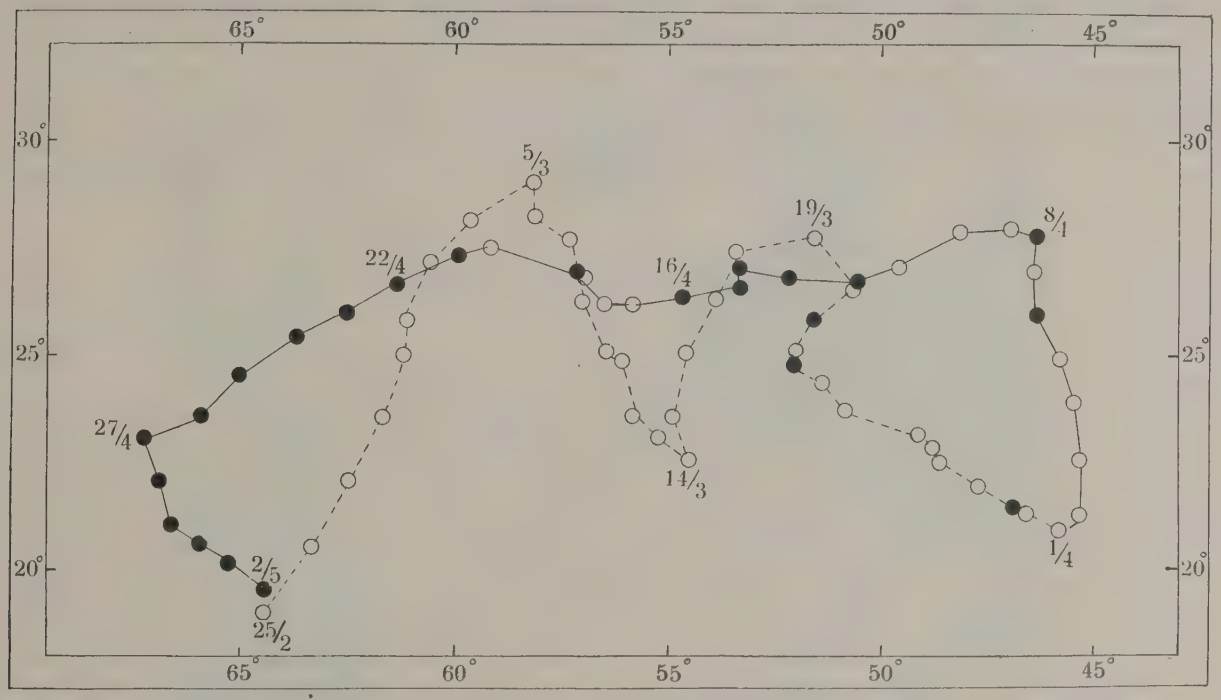


Fig. 10. Observations of storm petrels in the Sargasso Sea on the cruise of the M/S "Dana" in that sea area from the 25th Feb. to the 2nd May 1921. The route from the 25th Feb. to the 1st April is marked with a dotted line, the route from the 1st April to the 2nd May, with a continuous line. The black spots indicate where storm petrels were observed.

*Pelagodroma marina* (Lath.).

This very characteristic storm petrel was observed only a few times on the Danish expeditions in the North Atlantic viz. on the 5th April 1920 and the 28th July 1928 in the vicinity of Madeira and on the 9th April 1920 somewhat close to the Salvage Islands, north of the Canary Islands. The literature on the subject mentions the Salvage Islands, the Canary Islands and the Cape Verde Islands as breeding grounds in the North Atlantic.

## Order: Lariformes.

### Family *Laridæ*.

*Rissa tridactyla* (L.).

The common Kittiwake is the most pronounced species among the gull family. None of the north European gull species are met with so far out on the open ocean as this species. It breeds from arctic Europe and southward to the north coast of France and in America it is found breeding from Greenland down to the Gulf of St. Lawrence.

On the following chart (Fig. 11) are shown the places where the common Kittiwake was observed in the North Atlantic and figures indicating the months when observations were made on the various

routes. From the Faroes to the Azores the Kittiwake was observed in the month of July (7) only as far as 59° N. lat. In the same month there was a route from Scotland to New York and it will be noticed that this bird was then seen only north of Scotland. On the same route there were observations from December (12) and the species was then observed on the whole stretch across the Atlantic. From these observations it appears that on this stretch the Kittiwake is frequent in the winter while in the summer it is seldom met with. In August (8) there are observations from the Channel to New York and the species was then seen up to about 42° N. lat.

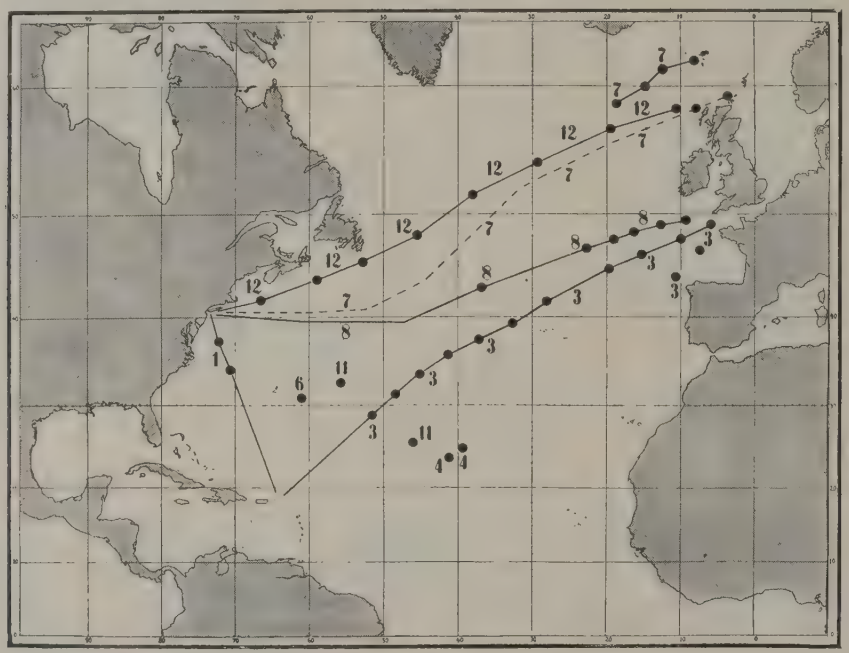

Fig. 11. *Rissa tridactyla.* Distribution in the North Atlantic. The dots show positions where the species was observed. The figures indicate the months (1—12) when the observations were made.

In the Sargasso Sea the Kittiwake is met with almost exclusively in the winter. For in spite of the very numerous observations made during the summer, only on one occasion was a Kittiwake seen in the Sargasso Sea in the summer proper viz. on the 11th June 1920 (30° N. lat.—60° W. long.). In the winter it is not quite rare in this sea. On the route from the West Indies to the Channel in March (3) for instance, the Kittiwake was seen for the first time already at 30° N. lat.—50° W. long. and after that daily right to the western part of the Channel. There are besides sundry observations of this bird in the Sargasso Sea from November (11) to April (4). It is remarkable that it is almost exclusively young birds that are seen in this sea during the winter half-year. In this connection it will be of interest to mention that Kramp (1913) on a voyage from the West Indies to the Channel in the month of February observed the Kittiwake for the first time at 30° N. lat.—51° W. long. and that it increased in numbers gradually as he approached the Azores. On that occasion also the great majority seen in the Sargasso Sea was composed of young birds.

It is evident from what has been stated above that the common Kittiwake occur much further south in the Atlantic during winter than during summer. The most southern position where the species has been observed lies at about 24° N. lat.—41° W. long.

## Family *Sternidæ.*

*Sterna paradisea* Brünn.

It is rather seldom that terns are met with out at sea, but this species has, however, repeatedly been seen even at a considerable distance from land. Thus a single specimen was observed on the 25th July 1913 (54° N. lat.—27° W. long.) and on the 29th July 1913 (52° N. lat.—27° W. long.), positions which lie about 600 miles from the nearest land (the west coast of Ireland). Furthermore the species was observed on the 16th Sept. 1913 in the north part of the Sargasso Sea about 250 miles S.E. of Newfoundland (44° N. lat.—50° W. long.). The breeding grounds of *Sterna paradisea* stretch from the Arctic regions southward, in Europe, to the British Isles and in America to Massachusetts. In winter it migrates right down to Argentina, South Africa and the Antarctic regions.

*Sterna hirundo* L.

Only on one single occasion was this tern determined with certainty at a great distance from land viz. on the 10th Sept. 1921 when an individual was seen circling around the ship at about 70 miles N.W. of Cape Finisterre.

*Sterna fuscata* L.

In the waters around the West Indies and during a voyage from off the coast of French Guiana to Barbados in November 1921 flocks of terns, which undoubtedly belonged to this species, were repeatedly seen. When the research vessel "Dana", on the 6th Nov. 1921, was lying S.W. of the Cape Verde Islands (about 13° N. lat.—31° W. long.) a great number of terns flew screaming around the ship at night. On this dark and rainy night, with a fresh breeze blowing, these birds must evidently have been attracted by the light on board. To judge from the appearance of these terns they were, as far as could be seen, the species *Sterna fuscata*, but as, according to the literature on the subject, this species breeds only along the coasts from the Gulf of Mexico to the West Indies and Venezuela and appears only more casually in the eastern part of the Atlantic, it is perhaps more likely that they were of another species.

? *Anous stolidus* (L.).

Only once (4th May 1920) was a small flock seen far out at sea, viz. about 200 miles N.E. of the island of Sombrero in the West Indies. As the birds were observed a great distance off, it is not impossible that they belonged to the somewhat smaller species *Megalopterus minutus* (Boie).

## Family *Stercorariidæ.*

*Catharacta skua* Brünn.

As will be seen from the chart (Fig. 12) below, where the positions of the great skua are marked together with the figures indicating the respective months (1—12), this species is encountered over a large portion of the northern Atlantic.

The great skua is particularly frequent north of 40° N. lat. where it has been observed both in summer and winter. Its occurrence south of 40° N. lat. is rather peculiar as besides having been seen in the Bay of Cadiz in October (10) it was observed only in the central part of the Sargasso Sea. It is of additional interest to notice that the observations from the Sargasso Sea were all made in the months of October, November and December (10, 11, 12). As it is precisely from this area that very numerous observations are available and, practically speaking, from all months of the year, the above observations go to show that the great skua is to be found in such southern latitudes only in the winter. The most southerly position where the great skua was seen in the Sargasso Sea was about 23° N. lat.—50° W. long. (5th Dec. 1913). In the literature on the subject Madeira (32°—33° N. lat.) is given as the

most southerly place the species is met with. Its breeding area stretches from Labrador and Greenland to Iceland, the Faroes, the Shetland and Orkney Islands.

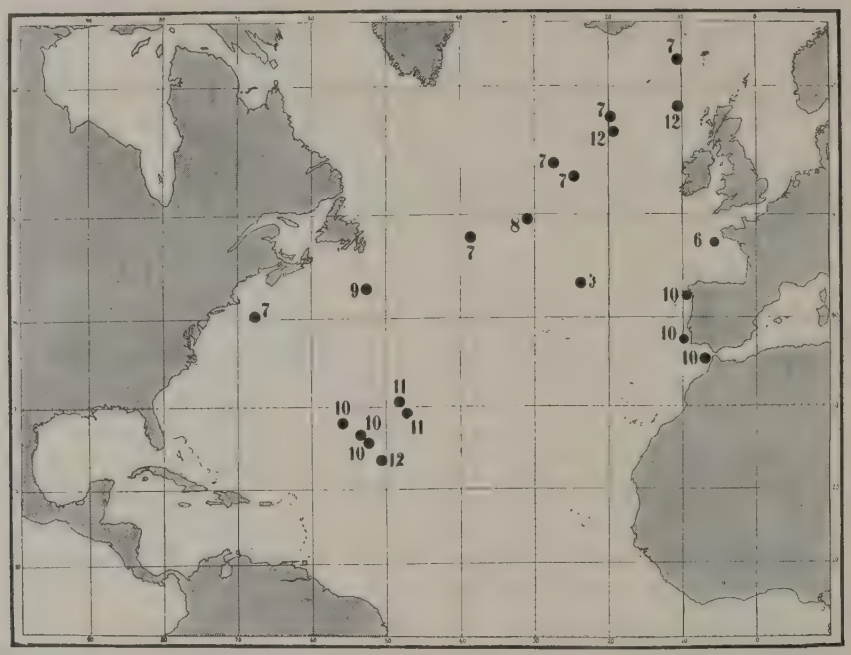


Fig. 12. *Catharacta skua.* Distribution in the North Atlantic. The figures (1—12) indicate the months when the observations took place.

*Stercorarius pomarinus* (Temm.) and *Stercorarius parasiticus* (L.).

It was often difficult to distinguish these two species of skua while seen flying over the sea. Thus it was not possible to determine the species of the young birds and so few perfectly certain data regarding these two species are, on the whole, available, that they would hardly give any reliable picture of their distribution. In the winter both species roam about widely and are, in fact, to be met with in the southern hemisphere.

*Stercorarius pomarinus* is a far more pronounced arctic breeding bird than the following species. Its breeding grounds are said to be found only in the arctic regions north of 70° N. lat. Over the open Atlantic it is, in fact, chiefly met with in the northern parts viz. north of 40° N. lat. Individual specimens have, however, in the winter been pointed out with certainty in the Sargasso Sea and also west of the Straits of Gibraltar and the coasts of Portugal.

*Stercorarius parasiticus* was met with sparsely within the area of observation though, in the summer, particularly north of 40° N. lat. In the winter half-year it was seen repeatedly in the Sargasso Sea As a rule it appears singly but occasionally two or three were seen together. In the autumn particularly it seems to be common along the coasts of western Europe. It breeds on the British Isles and also on the Faroes, Iceland, Greenland and in arctic North America.

*Stercorarius longicaudus* Vieill.

While the old birds of this species are easily recognisable, *inter alia,* by the greatly elongated central tail-feathers, it is hardly possible to determine with certainty the species of the young birds, when

in flight. The comparatively few observations of this species — which for the reasons mentioned include only adult birds — show that it was met with sparsely N. of 40° N. lat. in the months of July, August and September. In the Bay of Cadiz and to the west of the coast of Portugal there are a few observations, made in October, and in the Sargasso Sea single birds were observed three times in all, and strangely enough exclusively in the month of April. Finally a single bird was seen at about 10° N. lat.—39° W. long. in the month of November. An investigation of a specimen shot on the 27th July 1913 at 53° N. lat.—25° W. long. showed that in the gullet there was a rather large unrecognisable fish and that the stomach contained otoliths and bones of fish. One very often sees this species in the air being pursued by the larger species of skua. The breeding areas are exclusively in arctic America and Europe but it will be seen from the above observations that, when not breeding, this bird roams far towards the south.

## Order: Alciformes.

### Family *Alcidæ*.

*Alca torda* L.

But few observations of this species are available from the open sea and it has never been met with at any great distance from land. Around the Faroes, for instance, I never saw razor bills more than

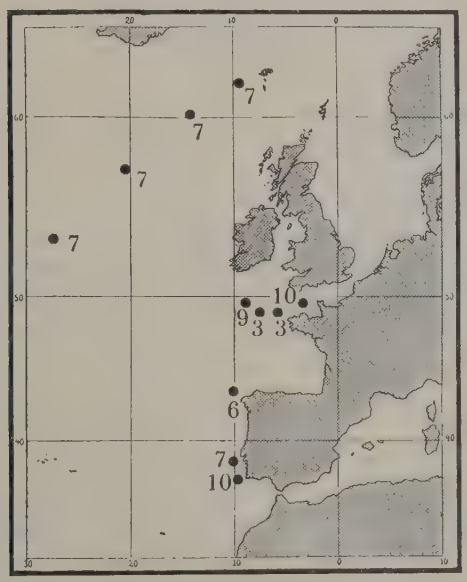


Fig. 13. *Uria aalge*. Positions where observations were made in the open sea. The figures 1—10 indicate the months when the observations were made.

Fig. 14. *Fratercula arctica*. Positions where observations were made in the open sea. The figures 1—10 indicate the months when the observations were made.

about 120 miles, at the highest, from the nearest land, but in the Bay of Biscay I, on one single occasion, noticed a razor bill about 150 miles from the coast of Brittany. In winter, it is said to migrate down to the Mediterranean and, in the Atlantic, to have been met with right down to the Canary Islands (Reichenow 1908) but on the cruises in these waters in March 1920 and October 1921 and 1929 this species was not observed. It has not with certainty been located further south than the Bay of Biscay which may probably be due to there being no observations from the middle of winter in the waters lying immediately south. The most southern breeding place of the razor bill we know, is Brittany.

*Uria aalge* (Pont.).

It is quite an exception to meet with the guillemot out on the open sea, but it has, however, been seen singly far out at sea, for instance in July 1913, when a single specimen was seen on the cruise from the Faroes down towards the Azores as far as about 54° N. lat.—27° W. long. where the distance to the nearest land (the west coast of Ireland) is about 600 miles. To the west of the Channel it has been observed as far as about 120 miles from the Scilly Islands; but, as a rule, the guillemot keeps closer to the land as when observed along the coasts of North Spain and Portugal (Fig. 13, p. 25).

*Fratercula arctica* (L.).

From the Faroes and southward, the puffin was seen, in July, out at sea up to about 56° N. lat. as shown on the chart fig. 14 (p. 25). The distance to the nearest land (the west coast of Ireland) from the most southern position was about 450 miles. It is only in very small numbers, however, that it is seen so far out at sea. On the above mentioned cruise from the Faroes and southward, in July 1913, it was not very generally seen until within 120 to 150 miles from land (Suderø, the Faroes). It has generally been observed in the vicinity of the coast of Brittany and also along the west coast of Portugal and in the Bay of Cadiz, where, in March, it is, as a rule, seen in small flocks but here it is always observed rather close to the land. In accordance with the literature on the subject (e. g. Reichenow 1908) it is said, in the winter, to be met with right down to the Canary Islands. Brittany and Portugal are given as its most southern breeding grounds.

## Order: Steganopodes.

### Family *Fregatidæ*.

*Fregata magnificens* Math.

The frigate bird is comparatively seldom seen out over the open sea. I, for my part, have only a couple of times seen it far from land viz. on the 16th Dec. 1913 (22° N. lat.—58° W. long.) and on the 3rd May 1920 (21° N. lat.—58° W. long.). On the first occasion there was only one bird and on the second two, which circled round very high up in the air. The distance to the nearest land was, on both occasions, two to three hundred miles. The reason why the frigate bird usually keeps so close to the coast is said to be that it has lost the ability to swim and I cannot remember ever having seen a frigate bird settled on the water.

On the following chart where the positions of the frigate birds observed are shown it will be seen that all these positions, with the exception of the two mentioned above, lie rather close to the land or immediately along the coast. All the observations are to be found only in the West Indian waters and on both sides of the Isthmus of Panama. In the latter area the frigate bird was frequently seen on the Pacific side (Gulf of Panama) and on the Atlantic side great numbers were seen flying in the harbour at Colon. Here they flew in small flocks close behind the ship, reminding one very much of the way gulls follow in the wake of a vessel. It was a magnificent sight to see these large birds in their graceful flight following quite close to the stern of the vessel. This must, however, be an isolated case of such behaviour on the part of the frigate bird. In no other places in the West Indies or in the East have I ever witnessed anything similar and it is presumably owing to the great amount of shipping at the entrance to the Panama Canal that the frigate bird has here become accustomed to this strange behaviour.

When the research vessel "Dana", in the winter of 1921—22, lay in the port of St. Thomas, the frigate bird was frequently observed in the harbour, but it appeared only in small numbers and was far more timid than at Colon. While I was at St. Thomas I never saw a frigate bird follow a ship sailing into or out of the harbour. In this connection it will be of interest to mention that on earlier visits to

St. Thomas I did not observe frigate birds in the harbour itself. In the winter of 1913—14 I stayed for about three months at St. Thomas and likewise for the whole of May 1920 but on neither of these occasions did I see the frigate bird flying in the harbour itself, as I did in the winter of 1921—22.

The flight of the frigate bird, as already mentioned, is extremely graceful, it is, in fact, generally considered to be the best flyer among birds and it is a pleasure to see this mighty bird glide and manœuvre adroitly in the air. It may often be seen soaring in great circles so high up in the sky that it is hardly visible to the naked eye, and in its flight it then reminds one of a large bird of prey. The usual way the frigate bird gets its food is by pursuing other birds until they drop their prey which it with great dexterity catches as it falls. With the greatest tenacity of purpose and lightning like evolutions it pursues

Fig. 15. *Fregata magnificens*. Positions where observations were made in the North Atlantic, the Caribbean Sea and the Gulf of Panama.

the birds through the air until they relinquish their booty. Investigation of a frigate bird from the Gulf of Panama showed that the stomach was full of the remains of cuttle fish.

The frigate bird breeds at several places in the West Indies and around the Caribbean Sea. Cleveland (1922) for instance gives the following localities: the Bahama Islands, Cuba, Porto Rico, Guadeloupe, Honduras and Venezuela. Alexander (1928) furthermore gives the Cape Verde Islands as a breeding place for this species.

## Family *Sulidæ*.

### *Sula leucogastra* (Bodd.).

In addition to this species there are two others that occur in the West Indian waters *Sula piscatrix* (L.) and *Sula dactylatra* (Less.), but while these two are met with only immediately near land, *Sula leucogastra* is occasionally seen rather far out at sea in the Caribbean Sea. On the 8th January 1922 a young specimen was caught which after flying around the ship for some time settled on board and was captured. The position was 12° N. lat.—76° W. long., about 120 miles from land. It was evidently very tired and after having rested on board for some time it was so tractable that it allowed itself to be touched without apparently minding it. We attempted to feed it with some flying fish which had flown on deck

during the night but it did not, however, show any inclination to eat them. It was kept on board for the night and allowed to fly away next morning.

*Sula bassana* (L.).

It is not quite exceptional to meet with this gannet out on the open sea, though it apparently prefers to keep rather close to land. On the annexed chart (Fig. 16) are given the positions where this species was observed together with a statement of the months when the observations were made. The gannet breeds, *inter alia*, on Iceland, the Faroes and the British Isles but, as will be seen from the chart, it roams rather widely about beyond its actual breeding area. A single bird was seen north of the Azores and also at Madeira and west of the Straits of Gibraltar. But it will be noticed that all these observations were made in the winter half-year (October to March) and there is therefore no doubt that the gannet migrates somewhat to the south in the winter. In the Straits of Gibraltar it appeared in rather large numbers in March 1920. The greatest distance from land at which the species was observed is about three hundred miles.

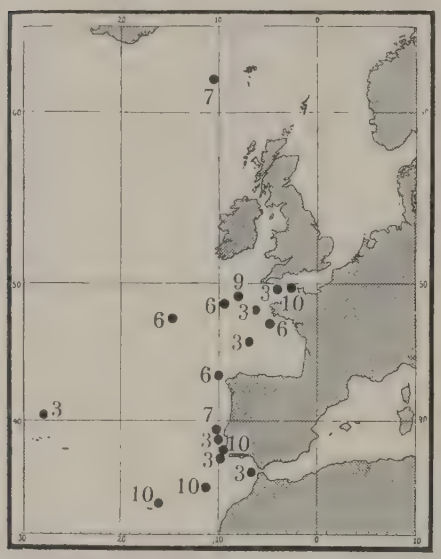

Fig. 16. *Sula bassana*. Positions where observations were made in the open sea. The figures 1—10 indicate the months when the observations were made.

Family ***Phaethontidæ***.

*Phaethon lepturus* Daud. and *Phaethon æthereus* L.

The above two species of tropic bird occur in the North Atlantic. According to Cleveland (1922) *Phaethon lepturus* is found breeding on the Bermudas, the Bahamas, Cuba, Jamaica, Haiti, Martinique, Dominica etc., while *Phaethon æthereus* is said to have breeding grounds on several of the small Antilles (St. Vincent, Grenada etc.). Alexander (1928) furthermore states that this species breeds on the Cape Verde Islands.

Both species were met with on the Danish expeditions in the Atlantic and the Caribbean Sea. The whole of the observations are given on the chart (Fig. 17) and it will be seen that the tropic bird, in the open Atlantic, is distinctly a denizen of the Sargasso Sea. All indisputable specific determinations of the tropic bird in the Sargasso Sea, point to the species *Phaethon lepturus* and this is only natural, for this species, as mentioned above, breeds, *inter alia*, on the Bermudas and the north Antilles. In the West Indian waters, both species have been observed, but the *Phaethon æthereus* has not, however, with certainty been encountered further north than around St. Thomas and St. Croix.

On the open Atlantic the tropic bird was observed up to about 40° N. lat. and in the eastern part of this ocean to about 22° W. long. It was, however, only quite exceptionally that this bird was seen east of 30° W. long. It was, for instance, met with everywhere within the Sargasso Sea proper but was distinctly most numerous in the western part of it. To give an idea of how often the tropic bird was observed on the open sea we give below the chart (Fig. 18) which shows the per cent number of observation days when the tropic bird was observed within areas of ten degrees of longitude and ten degrees of latitude. In the area which includes the Bermudas there is a distinct maximum of observations (59 %), which is due to the fact that this bird, in great numbers, breeds on these islands. If we consider the per cent number of observation days from the Bermudas and southward between 30° and 40° N. lat. it will be seen that it steadily decreases the further we get from these islands. Around 30° W. long. the number fall from 20 % right down to 0, as the tropic bird was not observed at all to the east of that

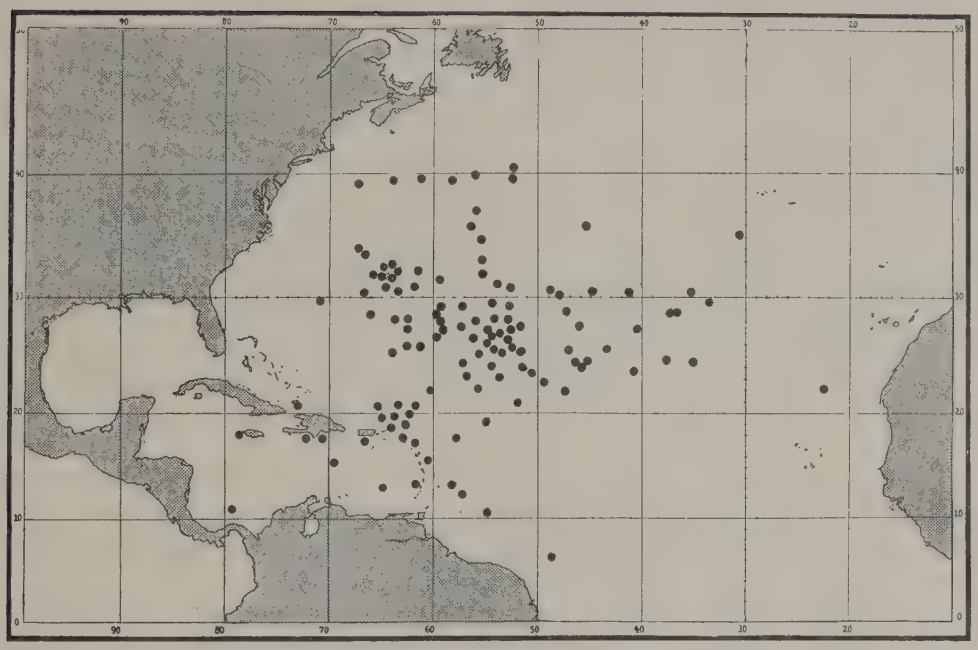

Fig. 17. All observations of tropic birds in the North Atlantic and the Caribbean Sea.

longitude. Another maximum of observation days as regards this bird is to be found between 10°—20° N. lat. and 50°—60° W. long. which is undoubtedly owing to its breeding on several of the small Antilles.

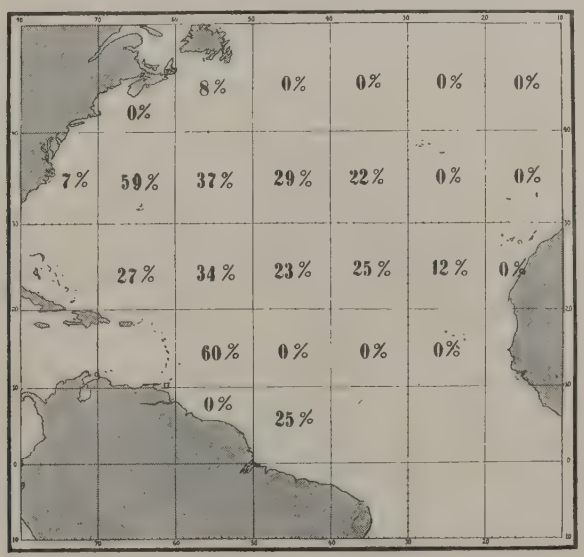


Fig. 18. The relative number of observation days within areas of ten degrees of longitude and ten degrees of latitude where the tropic bird was observed out on the open Atlantic.

Out at sea the tropic bird is not particularly sociable it being seen most often alone and never in large numbers. I have only twice seen three or four together and on both occasions it was relatively

close to land (60 to 80 miles from the Bermudas). The observation material to hand embraces in all 112 days, when the tropic bird was seen out on the open sea (at least fifty miles from the nearest land). Of this number there are only two days (1.8 %) on which three or four birds were observed together, twenty eight (25.0 %) when two were seen together and on all the rest of the days (73.2 %) the birds were observed one at a time.

In the warmer parts of the Atlantic the tropic bird is absolutely the most beautiful of all the ocean birds one meets with out at sea. When sailing in the Sargasso Sea one suddenly discovers rather a large bird, with pointed wings and greatly elongated tail feathers, flying over the ship. It is the tropic bird whose graceful white form stands out in such exquisite relief against the blue sky. It can be rather inquisetive and remain for a long time flying over the ship. On the schooner "Margrethe" I repeatedly noticed that a tropic bird for a long time kept pecking at the vane on the main mast as it hovered just above the truck. As a rule, however, it remains for only a few minutes over the ship or in its vicinity, and often gives utterance to its characteristic scream. The tropic bird is an efficient flyer and its flight is performed with short vigorous strokes of the wing. It is comparatively but a few times that I have seen this bird settle on the water out in the open ocean, and then always in fine weather without any sea worth mentioning. When settled on the water it always keeps the elongated tail feathers in a slanting position in the air. Undoubtedly it does not like wetting these feathers and it is presumably for this reason that it settles on the water only when the sea is smooth.

In bad weather one sees very little of the tropic bird out at sea and only on one occasion did I see one of them attempt to settle on the ship. In the ornithological diary of the cruise with the M/S "Margrethe" I noted the following on the 8th October 1913: "While a heavy thunder squall was gathering and a fresh breeze with water-sponts followed the rain, a tropic bird came flying low over the water towards the stern of the vessel. It attempted repeatedly to settle on the yard of the main sail which protuded somewhat over the port railing. Several times its feet were only a slight distance from the yard but at last it gave up the attempt. When a water-spont came quite close to the ship the strong wind flung the bird, which was evidently greatly exhausted, low over the surface of the water, and I saw it no more".

The way the tropic-bird seeks its food is by plunging into the water. I have rather often had the opportunity of examining the contents of its stomach and found that the food consisted exclusively of cuttle fish. Stomach analyses were made in the case of eight birds in all. Of these, two had nothing in their stomachs while the other six contained the remains of cuttle fish. Of course there can only be a question of relatively small cuttle fish though on one occasion I found one measuring 12 cm., in the contents of a stomach. As all the tropic birds I had an opportunity of examining were shot out on the open sea, this may possibly explain why the food was always the same. Other authors as, for instance, Gross (1912) likewise state that the tropic bird lives, for the most, on cuttle fish, but it is said also to be able to eat little fish, *inter alia*, young flying fish.

On the Bermudas which are the most northern breeding places in the Atlantic, the tropic bird is a bird of passage. In conformity with this I saw only a single specimen when about the 1st Nov. 1913, I lay for a week off these islands. On the contrary, during subsequent visits to the Bermudas in July 1920 and in May 1922, the bird appeared in large numbers. On these islands the tropic bird lays its eggs in holes in the ground and the rocks, and the old bird sits so stedfastly on its eggs that one can take hold of it on its nest. It doesn't however willingly put of with such treatment but pecks vigorously with its beak if one tries to remove it from the nest.

## Order: Limicolæ.

### Family *Charadriidæ.*

*Phalaropus sp.*

It is extremely seldom that wading birds are met with out on the open sea. Occasionally single birds were seen flying at a long distance from the ship but in such cases any determination of species was quite out of the question. The only wading birds which may correctly be said — at any rate at certain times of the year — to be denizens of the open ocean are the genus *Phalaropus* and occasionally these characteristic birds have been observed far out at sea. As they were observed at rather a great distance it was not possible, in any of the instances recorded, to identify the species but there can hardly be any doubt that they were either the species *Phalaropus fulicarius* (L.) or *Phalaropus lobatus* (L.). As the positions of the birds observed are somewhat peculiar they are given below with their approximate distances from the nearest land:

3rd Aug. 1913. 50° N. lat.—30° W. long., about 650 miles north of the Azores. Observed first one and, later on, two birds that flew for a time around the ship and then settled on the water.
8th Sept. 1913. 32° N. lat.—42° W. long., about 750 miles S.W. of the Azores. One bird.
28th Sept. 1913. 40° N. lat.—54° W. long., about 380 miles S. of Newfoundland. Four birds that rose from the water at a considerable distance from the ship.
18th Aug. 1920. 40° N. lat.—52° W. long., about 390 miles S. of Newfoundland. One bird.

It is worthy of remark that all the observations were made in the months of August and September and thus there can hardly be any doubt that they were birds which, in the autumn, were migrating towards southern latitudes.

*Capella media* (Lath.).

A single specimen of this species was observed on the 24th March 1920 in the Bay of Cadiz, where it circled several times round the ship and made an unsuccessful attempt to settle on the poop.

## Order: Raptatores.

### Family *Falconidæ.*

? *Haliaetus albicilla* (L.).

On the 31st March 1920, off Cape Spartel on the north coast of Marocco an eagle, belonging probably to the above species, came circling low over the water in front of the ship's bows. Distance from land about 60 miles.

*Falco tinnunculus* (L.).

A good fifty miles west of the Straits of Gibraltar, on the 31st March 1920 a kestrel was observed and on the 14th Sept. 1921 a specimen was seen in the Bay of Cadiz. The latter however may possibly have belonged to the species, *Falco naumanni* (Fleischer).

## Order: Columbiformes.

### Family *Columbidæ.*

On the 4th Dec. 1913 a pigeon (*Columba domestica*?) was observed flying high in the southern part of the Sargasso Sea (about 23° N. lat.—50° W. long.). The distance to the nearest land (Sombrero,

West Indies) was about 800 miles. On the 17th July 1920 south of Nova Scotia (40° N. lat.—60° W. long.) a pigeon was for a time seen flying around the ship. The distance to land was about 300 miles. On the 23rd June 1928, in the Bay of Biscay about 70 miles from land nine tame pigeons came on board in an extremely exhausted condition. They flew restlessly around the ship settling now on the railings and ropes, now on the radio antennæ and the edge of the funnel. All those that could be got hold of had a rubber ring on one foot. Gradually they were all caught, to be set free next morning.

*Streptopelia turtur* L.

On the 11th Oct. 1921, in the Bay of Cadiz, two turtle doves were seen around the ship and the following day another couple appeared and settled on the vessel. They were exhausted and one of them allowed itself to be taken in the hands. The distance from the coast of Marocco was about 150 miles.

## Order: Coraciiformes.

### Family *Upupidæ.*

*Upupa epops* L.

When the research vessel "Dana" was lying in the Straits of Gibraltar and the Bay of Cadiz in September 1921 the hoopoe was rather often seen around the ship. It was seen only one at a time but out at sea it was observed on the 14th Sept., the 20th Sept. and the 21th Sept. so doubtless they were different individuals. One of these birds, which appeared to be rather exhausted, circled round the ship for a quarter of an hour and settled on board several times, but always only for a moment. The nearest land (the coast of Marocco) then lay about 120 miles from the ship's position.

## Order: Passeres.

### Family *Fringillidæ.*

*Fringilla coelebs* L.

When the air was thick with snow, four of this species (♀♀) fluttered around the vessel on the 28th March 1914 in the western part of the Channel, about 100 miles S. of Scilly Islands.

### Family *Motacillidæ.*

*Motacilla alba* L.

On the 20th March 1920, a specimen flew low over the ship as she lay about fifty miles north of Cape Finisterre.

*Motacilla cinerea* Tunst.

On the 24th March 1920, while the M/S "Dana" was lying in the Bay of Cadiz, a specimen of this species settled on the deck, where it remained for half an hour.

*Anthus sp.*

On the 14th Sept. 1921 when the research vessel was employed in making investigations in the Bay of Cadiz, a specimen of the family *Anthus* settled on board for a moment, but we were unable to identify the species more exactly.

## Family *Muscicapidæ.*

*Muscicapa striata* (Pall.).

On the 13th Sept. 1913, when the ship was lying in the Bay of Cadiz, off Cap St. Vincent (Portugal), a spotted flycatcher settled on the railing.

## Family *Tyrannidæ.*

*Empidonax sp.*

On the 2nd May 1920, a specimen of this family flew on board at 22° N. lat.—55° W. long., the distance from land (Sombrero) was about 450 miles.

## Family *Sylviidæ.*

*Sylvia atricapilla* (L.).

On the 4th April 1920, a specimen of this species appeared on board at about 120 miles north of the island Porto Santo near Madeira (about 35° N. lat.—16° W. long.).

*Phylloscopus sibilatrix* (Bechst.).

Off the coast of Portugal (41° N. lat.—11° W. long.) a bird of this species was observed flying about the deck. It was very docile and not timid at being approached closely.

## Family *Turdidæ.*

*Phoenicurus phoenicurus* (L.).

Seen around the ship in the Bay of Biscay on the 19th March 1920 (two birds) and in the Bay of Cadiz on the 11th Oct. 1921.

*Planesticus migratorius* (L.).

A specimen of this species flew on board the schooner "Margrethe" on the 24th Oct. 1913 when she was lying about 250 miles east of the Bermudas (32° N. lat.—59° W. long.). It remained on board for a day but refused all nourishment. According to the literature on the subject, this species is said to occur only as a casual visitor on the Bermudas, and there can be hardly any doubt that this specimen had wandered far out of its actual migratory route.

*Oenanthe oenanthe* (L.).

On the 13th September 1913 when the "Margrethe" was lying in the Atlantic, to the south east of Newfoundland, a wheatear came flying low and uncertainly over the water and presently throw itself on to the deck. It was picked up by one of the seamen and made no attempt to escape. It was so exhausted that it was unable to stand. The distance to the nearest land (Newfoundland) from the spot where the vessel was then lying (about 37° N. lat.—46° W. long.), was about 600 miles. The bird was nursed on board but died the next day. It belonged to the subspecies *Oenanthe oenanthe leucorrhoa* (Gm.).

*Oenanthe hispanica* (L.).

An individual of this south European species was for a moment on board in the Bay of Cadiz, on the 23rd Sept. 1921.

## Family *Hirundinidæ.*

*Hirundo rustica* L.

Swallows were frequently seen over the ocean in the migratory season. On the 13th Aug. 1913 one was seen north west of the Azores (about 43° N. lat.—31° W. long.). Furthermore the species was observed — several at a time — on the 21st and 22nd of March 1920, at a distance of a good fifty miles from the west coast of Portugal. On the same stretch, as well as in the Bay of Cadiz, many swallows were seen around the ship on the 1st and 2nd October 1929. At times ten to fifteen birds settled on board. Moreover several swallows were frequently seen to pass the ship in a southerly direction.

*Hirundo erythrogastra* Bodd.

On two occasions this species was observed out at sea. On the 15th Aug. 1920 a specimen flew on board the M/S "Dana" about 300 miles south of Nova Scotia (about 39° N. lat.—61° W. long.). It stayed in the salon of the vessel where it caught flies. After being a couple of days on board it disappeared. Another specimen was seen on the 13th Aug. 1928 in the Sargasso Sea (21° N. lat.—52° W. long.), about 600 miles from land. After flying around the ship for a time it set off in a southerly direction.

? *Delichon urbica* L.

On the 21st March 1920, a swallow, presumably of this species, was seen flying around the ship while off the west coast of Portugal, a good fifty miles out at sea.

*Riparia riparia* (L.).

On the 4th Dec. 1913, in the southern part of the Sargasso Sea (about 23° N. lat.—50° W. long.), a sand-martin flew around the M/S "Margrethe". A fresh breeze was blowing from the south west and the bird kept under the lee of the sails but was flung by the strong wind out over the sea where it apparently disappeared in the waves. When this happened we were at least about 750 miles from the nearest land (Sombrero, the West Indies).

---

It is only natural that land birds, to a far greater extent, are seen near the coasts when in the migratory season they travel to and from their breeding grounds and this in fact must already be apparent from the above cited observations regarding actual land birds. As it is certain that many land birds that travel over the larger areas of the oceans, do so only involuntarily, the observations of such birds out over the open sea acquire, of course, a more casual character. It is however interesting to see where these birds were observed and therefore the positions where land birds were observed in the open Atlantic (distance to the nearest land at least fifty miles) are marked with dots on the chart (Fig. 19) given below.

The chart gives all observations of land birds out on the open sea, it also gives birds which, on account of the distance, it was not possible to determine more exactly but merely to refer to one of the three orders here concerned viz. *Passeres, Columbiformes* and *Raptatores.*

It will at once be noticed that the observations fall into two distinct groups viz. an eastern and a western, there being but extremely few observations between 20° and 50° W. long. The two groups embrace, certainly in the main, birds indigenous respectively to Europe and to America. Along the west coasts of Europe there are many observations of land birds right from the western part of the Channel, the Bay of Biscay and along the west coast of Portugal to the southern part of the Bay of Cadiz but it

will be seen that all the observations lie relatively near land. This, on the contrary, cannot be said of the western part of the Atlantic, where there is a very fair number of observations even at very considerable distances from land. Even though there are far more observation days in the Sargasso Sea than in the eastern Atlantic, the great difference in the distribution of the places of observation in the two areas of the Atlantic is yet very obvious. That nearly all the positions in the western area of the Atlantic lie between 50° and 70° W. long., and none between 70° and 80° W. long., must certainly be ascribed to the circumstance, that relatively few observations were made in the latter area.

From the above observation material it would appear that the North American birds of passage migrate to a far greater extent over the open sea than the migratory birds of Europe. Now matters un-

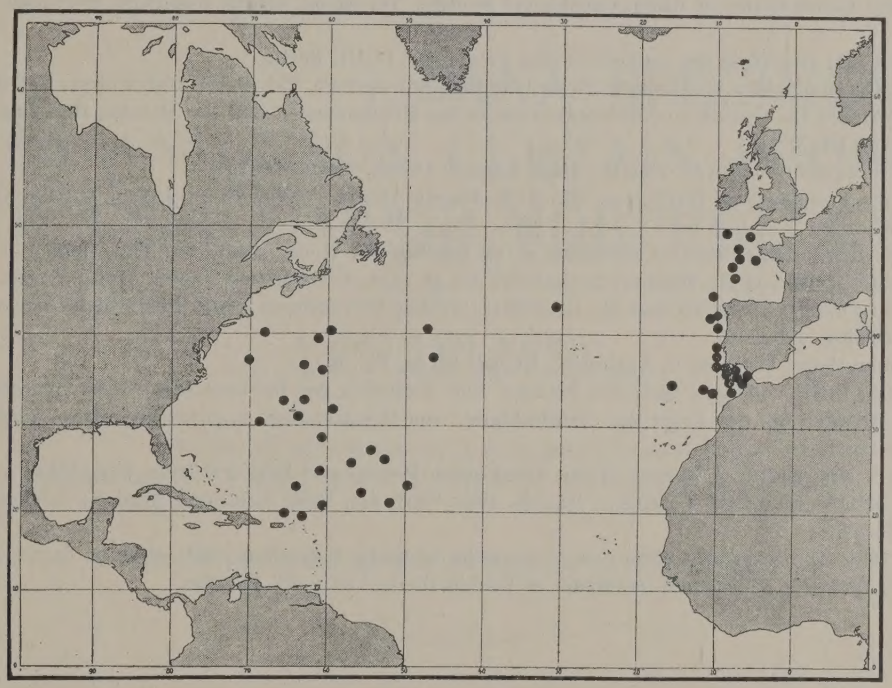

Fig. 19. Positions of land birds observed out on the open sea. (Distance to the nearest land at least fifty miles).

doubtedly stand thus, that the North American land birds, in their journyings to and from the southern regions, must necessarily pass over more open sea — viz. the Caribbean Sea — than the North European birds of passage which are not, to so great an extent, obliged to betake themselves out over the Atlantic. It is, I should say, hardly probable that there is positively a regular migration of birds over the western part of the Sargasso Sea, but circumstances to a high degree, seem to suggest that it is not anything entirely unusual for birds of passage to be compelled, presumably by the weather conditions, to seek their way out over the open sea between the Bermudas and Florida. That the European birds of passage are so comparatively seldom met with far out at sea, may possibly be explained by the circumstance that it is the westerly wind that, to a pronounced degree, predominates along the coast of western Europe.

# LIST OF PUBLICATIONS CITED


ALEXANDER, W. B. 1928: Birds of the Ocean. New York-London.

CLEVELAND, B. A. 1922: Life-Histories of North American Petrels and Pelicans and their Allies. Order *Tubinares* et *Steganopodes*. Bull. U. S. Nat. Mus. No. 121, XII.

DAHL, FR. 1892: Die auf der Plankton-Expedition beobachteten Säugethiere, Vögel und Schildkröten des Meeres. Ergebnisse der Plankton-Expedition. Vol. I, A.

GODMAN, FR. d. CANE 1908—09: A Monograph of the Petrels (Order *Tubinares*).

GROSS, A. O. 1912: Observations on the yellow-billed Tropic-Bird (*Phäeton americanus* Grant) at the Bermuda Islands. The Auk, Vol. XXIX, No. 1.

HAGERUP, O. 1926: Communities of Birds. Oecological Studies. Vid. Medd. Dansk Naturhist. Forening, Vol. 82. Copenhagen.

HARTERT, E. 1910—22: Die Vögel der paläarktischen Fauna. Bd. I—III. Berlin.

HELMS, O. 1897: Ornithologiske Iagttagelser fra det nordlige Atlanterhav. Vid. Medd. Nat. Foren., Vol. 59. Copenhagen.

JESPERSEN, P. 1923: On the Quantity of Macroplankton in the Mediterranean and the Atlantic. Rep. Dan. Ocean. Exped. 1908—10, Vol. III, 3.

— 1924: The Frequency of Birds over the High Atlantic Ocean. "Nature" 1924.

— 1929: On the Frequency of Birds over the High Atlantic Ocean. Verhandl. VI. Intern. Ornith.-Kongres. Kopenhagen 1926.

JOHNSEN, S. 1924: Havhesten (*Fulmarus glacialis*), en ny rugefugl for Norge. "Naturen" 1924, Bergen.

KRAMP, P. L. 1913: Ornithologiske Dagbogs-Optegnelser fra et Togt til Vestindien. Dansk ornith. Foren. Tidsskrift, VII.

LIDNER, FR. 1919: *Fulmarus glacialis* und die neuerdings erfolgte Erweiterung seines Brutgebietes nach Süden (Irland). Journ. f. Ornith., Jahrg. 67.

— 1922: Fulmar Petrel breeding in Yorkshire. British Birds, Vol. 16.

LOHMANN, H. 1912: Untersuchungen über das Planzen- und Tierleben der Hochsee zugleich ein Bericht über die biologischen Arbeiten auf der Fahrt der "Deutschland" von Bremerhaven nach Buenos Aires. Veröffentl. des Inst. für Meereskunde N. F., Heft 1.

LOOMIS, LEVERETT MILLS 1918: A Review of the Albatrosses, Petrels and Diving Petrels. Expedition of the California Academy of Sciences to the Galapagos Islands, 1905—1906. XII. Proc. California Acad. of Sciences, Fourt Series, Vol. LI, No. 12.

REICHENOW, A. 1908: Die Vögel des Weltmeeres. Deutsche Südpolar-Expedition 1901—1903, IX. Band, Zoologie, Bd. I.

WITHERBY, H. F. 1920—23: A practical handbook of British Birds. Vol. I—II. London.